FINAL

PRELIMINARY ASSESSMENT/ SITE INSPECTION REPORT FOR THE CARPENTER AND SNOW CREEK MINING COMPLEX SITE NEIHART, MONTANA

CERCLIS ID #MTD0001096353

Submitted to:

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In accordance with:

EPA/MDEQ Multi-Site
Cooperative Agreement #V008430-01

Submitted by:

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

LIST OF APPENDICES

LIST OF FIGURES

LIST OF FIGURES (cont'd.)

LIST OF TABLES

LIST OF TABLES (cont'd.)

I. INTRODUCTION

This Preliminary Assessment/Site Inspection Report for the Carpenter and Snow Creek Mining Complex Site (CERCLIS ID#MTD0001096353) located near Neihart, Montana, was prepared by Pioneer Technical Services, Inc. (Pioneer), for the Montana Department of Environmental Quality/Environmental Remediation Division (MDEQ/ERD). This report satisfies the provisions of Phase IV, Task H of the MDEQ Contract No. 430005, Task Order No. 18, and is pursuant to U.S. Environmental Protection Agency (EPA)/MDEQ Multi-site Cooperative Agreement #V008430-01. This task order requires Pioneer conduct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) combined Preliminary Assessment (PA)/Site Inspection (SI) at this site. The PA/SI was completed in four phases: Phase I included the site history report and the sampling and analysis plan; Phase II included sampling and the sampling activities report; Phase III included the analytical results report; and Phase IV includes the final PA/SI report, a compilation of Phases I through III with MDEQ comments incorporated.

The required PA forms are included in appendices; the CERCLA eligibility questionnaire is presented as Appendix A, the latitude and longitude calculation worksheet is presented as Appendix B, and the EPA Region VIII PA worksheet is presented as Appendix C.

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II. SITE HISTORY

1.0 SITE INSPECTION OBJECTIVES

Acquisition of additional information through sampling may be necessary to accurately characterize sources at the site, to define migration pathways and releases, and to assess potential human and environmental targets. The purposes of sampling during a SI are to address hypotheses regarding contaminant sources or contaminant migration pathways, acquire data necessary to attribute contamination to the site, collect or document data for significant migration pathways, and provide thorough documentation of site and receptor information necessary to support a hazard ranking system (HRS) scoring.

The specific PA/SI objectives at the Carpenter and Snow Creek Mining Complex Site are listed below:

- Determine background soil, groundwater, and surface water concentrations in accordance with HRS guidelines;
- Document potential sources of contamination;
- Collect additional on-site and off-site groundwater data from existing wells;
- Document targets for the groundwater, surface water, soil exposure, and air pathways, including drinking water intakes/wells, fisheries, threatened/endangered species habitat, and wetlands;
- Determine if any nearby drinking water wells are exposed to Level I/II contamination;
- Determine if nearby fisheries are exposed to Level II contamination; and
- Upon MDEQ written request and approval, evaluate the potential for the site to be listed on the National Priorities List (NPL) by conducting a preliminary HRS scoring.

2.0 SITE DESCRIPTION

2.1 <u>LOCATION</u>

The Carpenter and Snow Creek Mining Complex Site is located northeast of Neihart, Montana (Figure 1), and consists of abandoned and inactive hardrock mine sites that produced gold, silver, lead, zinc, and copper (Pioneer, 1994b through g and Pioneer, 1993a through h). The site is reached by traveling from Great Falls, Montana, south (approximately 55 miles) on Highway 89 toward Neihart. Approximately one mile north of Neihart, Carpenter Creek intersects Belt Creek. At the confluence, there is a gravel road (Forest Road 3323) which travels along Carpenter Creek toward the northwest. This road accesses all of the mine sites. The site boundary includes the entire drainage basin of Carpenter Creek, which includes the Snow Cre drainage basin. Aerial photographs of the Carpenter and Snow Creek Mining Complex Site a located at the MDEQ/Abandoned Mine Reclamation Bureau (AMRB). The site contains priv mining claims within the U.S. Department of Agriculture/Forest Service (USFS), Lewis and Clark National Forest.

The Neihart mining district includes the Carpenter and Snow Creek Mining Complex Site, as well as several mine sites closer to Neihart that are not within the basin. The MDEQ/AMRB database of mine sites lists a total of 96 mines in the Neihart mining district, at least 21 of whi are located within the site boundary. Several possible contaminant sources include mining wastes at the following sites:

1) the Hutchinson Mine Site (50 feet from Snow Creek);

2) the Snow Creek Mill Site (along Snow Creek);

3) the Lexington No. 4 (includes Lexington No. 3) Mine Site (100 feet from an unnamed tributary of Snow Creek);

4) the Ripple Mines (includes Ripple No. 1, No. 2, No. 3, and No. 4) Site (at least 100 fe from an unnamed tributary of Snow Creek);

5) the Upper and Lower Rebellion Mine Site (in an unnamed tributary of Snow Creek);

6) the Emma Mine Site (in Squaw Creek);

The above six sites were investigated in 1994 by Pioneer personnel during the MDEQ/AMRE Hazardous Materials Inventory (see Figure 2).

7) the Big Seven Mine Site (in an unnamed tributary of Snow Creek);

8) the Baker Mine Site (adjacent to Mackay Creek);

9) the Vilipa Mine Site (in Mackay Creek);

10) the Carpenter Creek Tailings Site (in Carpenter Creek);

11) the Silver Dyke Mill Site (50 feet to Squaw Creek);

12) the Silver Dyke Tailings Site (in Carpenter Creek);

13) the Silver Dyke Adit Site (in Squaw Creek); and

14) the Sherman No. 2 (Northeast and Southwest) Mine Site (adjacent to Burg Creek).

The above eight sites were investigated in 1993 by Pioneer personnel during the MDEQ/AMRB Hazardous Materials Inventory (see Figure 2).

15) the IXL-Eureka Mines Site (in an unnamed tributary of Snow Creek);

16) the Lucky Strike Mine Site (adjacent to an unnamed tributary of Snow Creek);

17) the Cornucopia-Ontario Mines Site (in an unnamed tributary of Snow Creek);

18) the Benton Mine Site (in an unnamed tributary of Snow Creek);

19) the Black Diamond Jay Mine Site (adjacent to an unnamed tributary of Snow Creek);

20) the Cowboy Mine Site (adjacent to Lucy Creek); and

21) the Haystack Creek Mine Site (in Haystack Creek).

The above seven sites were investigated during the 1995 MDEQ/AMRB Hazardous Materials Inventory; however, data was collected after this investigation.

The site is located in Township 14 North, Range 8 East, Sections 9, 10, 11,13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 27, and 28 of Cascade County, Montana. The geographic coordinates at the intersection of Snow Creek and Carpenter Creek (downgradient of all sites) are: 46° 57' 41.89" North latitude and 110° 43' 33.46" West longitude. The entire drainage basin area is estimated at 5,000 acres. The acreage of the disturbed area has been estimated for the following specific sites: Snow Creek Mill Site, approximately 0.25 acre; Lexington No. 4 Mine Site, approximately 1 acre; Ripple Mine Site, approximately 3 acres; Upper and Lower Rebellion Mine Site, approximately 5 acres; Emma Mine Site, approximately 0.25 acre; Big Seven Mine Site, approximately 11.5 acres; Baker Mine Site, approximately 0.5 acre; Vilipa Mine Site, approximately 6 acres; Carpenter Creek Tailings Site, approximately 15.6 acres; Silver Dyke Mill Site, approximately 16 acres; Silver Dyke Tailings Site, approximately 4 acres; Silver Dyke Adit Site, approximately 4 acres; and Sherman No. 2 (Southwest), approximately 0.14 acre (see Figures 4 through 16). The acreage of other mine sites in the area has not been determined.

2.2 OPERATIONAL HISTORY

Claims were located in the area as early as 1883 and mining began in the area as early as 1897. The major mining operations ended by 1950. The Silver Dyke Mill Site probably flumed tailings to create both the Carpenter Creek Tailings Site, present since 1935, and the Silver Dyke Tailings Site. The 500-ton (per day) flotation mill at the Silver Dyke Mill Site was built in 1921 to handle

1,000,000 tons of ore; the mill was upgraded to 950-ton (per day) in 1926. The mill at the Big Seven Mine Site was a 100-ton (per day) flotation mill that was remodeled to a 150-ton (per d mill in 1943. Most mines were worked sporadically during the five decades of mining (Pione 1994b through g and Pioneer, 1993a through h).

2.3 PREVIOUS SAMPLING

A great deal of investigation and sampling has been performed at the Carpenter and Snow Cre Mining Complex Site. Previously collected waste rock, tailings, groundwater, surface water, soils, and sediment data at the site required evaluation for completeness and usability for HRS scoring.

2.3.1 *1994 MDEQ/AMRB Hazardous Materials Inventory Investigation*

2.3.1.1 Hutchinson Mine Site

The Hutchinson Mine Site was sampled in June 1994, by Pioneer for the MDEQ/AMRB. Th slope of the site was approximately 20 degrees. Access was gained on a four-wheel drive (4V road with no restrictions. There were approximately 130 cubic yards of vegetated waste rock located in one dump; no sample was collected because the dump was revegetated and approximately 50 feet from Snow Creek. The waste rock was uncontained and had a low pH (5.0). There was one flowing adit (07-177-AD-1) on-site that was sampled; pH was 5.74 and flow rate was estimated at 5 gallons per minute (gpm). There was no background soil sample collected because there was no on-site source material collected (Pioneer, 1994b). Sample locations are presented in Figure 3 and sample results are presented in Table 1.

There was no upgradient groundwater sample collected to compare to the adit discharge. Inst the adit discharge sample was compared with drinking water Maximum Contaminant Levels (MCLs), the maximum permissible level of a contaminant in water which is delivered to any of a public water system; no MCLs were exceeded.

2.3.1.2 Snow Creek Mill Site

The Snow Creek Mill Site was sampled in July 1994, by Pioneer for the MDEQ/AMRB. The slope of the site was approximately 10 degrees. Access was gained on a 4WD road with no restrictions. There were approximately 183 cubic yards of mostly unvegetated tailings in thre areas (a deteriorating 16.5 foot diameter wood vat and two uncontained piles) that were composited and sampled (07-505-TP-1). The tailings were approximately 10 feet from Snow Creek; the tailings had a pH from 5.4 to 7.1. Paired surface water and sediment were sample upstream and downstream in Snow Creek (07-505-SW-2/SE-2 and SW-1/SE-1, respectively) Flow rate was measured at 1.74 cubic feet per second (cfs) and pH was 8.55 upstream and 8.: downstream. A background soil sample was collected near the Ripple Mine (07-163-SS-1) because of proximity of the two sites (Pioneer, 1994c). Sample locations are presented in Fig 4 and sample results are presented in Table 1.

Antimony, copper, lead, mercury, silver, and zinc were elevated at least three times above background concentrations or above the detection limit, if background was not detected, in the tailings. Cyanide was reported at 3.5 ppm; there is no background concentrations of cyanide to compare this to because cyanide is not naturally occurring. There were no elevated levels of metals in surface water or sediment.

2.3.1.3 Lexington No. 4 Mine Site

The Lexington No. 4 Mine Site (which includes the Lexington No. 3) was sampled in June 1994, by Pioneer for the MDEQ/AMRB. The slope of the site was approximately 28 degrees. Access to the site, via a 4WD road, was restricted because of a locked gate. There were approximately 6,600 cubic yards of mostly uncovered waste rock in two dumps that were composited and sampled (07-167-WR-1). The dumps were uncontained; however, there was no surface water in proximity to the site. There was one flowing adit which ran over and adjacent to the lower dump. The adit discharge was sampled at the mouth (07-167-AD-1) and after flowing over and around the dump (07-167-SW-1). The sample at the adit mouth had a pH of 7.94 and an estimated flow rate of 18 gpm. The lower sample had a pH of 6.68 and an estimated flow rate of 15 gpm. A background soil sample (07-163-SS-1) was collected near the Ripple Mines Site because of the proximity of the two sites (Pioneer, 1994d). Sample locations are presented in Figure 5 and sample results are presented in Table 1.

Antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in waste rock. There was no upstream surface water to compare to downstream surface water. There was no upgradient groundwater to compare to the adit discharge; however, cadmium exceeded the MCL and lead exceeded the action level.

2.3.1.4 Ripple Mines Site

The Ripple Mines Site (includes the Ripple No. 1, No. 2, No. 3, and No. 4) was sampled in June 1994, by Pioneer for the MDEQ/AMRB. The slope of the site was estimated at 28 degrees. Access to the site was gained on a 4WD road with two locked gates. There were approximately 6,100 cubic yards of uncovered waste rock in three dumps that were composited and sampled (07-163-WR-1 and 3). The waste rock was uncontained and located in intermittent drainages; however, there was no surface water on-site, other than adit discharges. There were four discharging adits on-site and all were sampled at the mouth of each adit (07-163-AD-1A, -1B, -2, and -3). Sample 07-163-AD-1A had a pH of 3.66 and an estimated flow rate of 7 gpm; sample 07-163-AD-1B had a pH of 6.64 and an estimated flow rate of 4 gpm; sample 07-163-AD-2 had a pH of 6.86 and an estimated flow rate of 3 gpm; and sample 07-163-AD-3 had a pH of 5.85 and an estimated flow rate of 5 gpm. Three of the four adit discharges (07-163-AD-1A, -1B, and -2) flowed over the dumps and joined together; a water sample (07-163-SW-1) was collected at the point of confluence and the pH was 3.82. The background soil sample was collected (07-163-SS-1) near the site (Pioneer, 1994e). Sample locations are presented in Figure 6 and sample results are presented in Table 1.

Arsenic, barium, cadmium, copper, lead, mercury, silver, and zinc were elevated at least three times background concentrations in waste rock. There was no upstream surface water to compare to the downstream water sample (combined adit discharges); however, the MCL for cadmium and the action level for lead were exceeded in this sample. There was no upgradient groundwater to compare to the discharging adits; however, the MCL for arsenic was exceeded one sample (07-163-AD-1A), the MCL for cadmium was exceeded in two samples (07-163-Al 1A and -3), and the action level for lead was exceeded in two samples (07-163-AD-1B and -3).

2.3.1.5 Upper and Lower Rebellion Mine Site

The Upper and Lower Rebellion Mine Site was sampled in June 1994, by Pioneer for the MDEQ/AMRB. The site slope was approximately 23 degrees. Access to the site was on a 4W road; a locked gate exists 0.5 miles below the site. There were approximately 64,920 cubic yaı of mostly uncovered waste rock in six dumps that were composited and sampled (07-157-WR- and 2 and 07-158-WR-1). The uncontained waste rock was located in a tributary of Snow Cre There were three discharging adits (07-157-AD-1 and 2 and 07-158-AD-1) that were sampled. Sample 07-157-AD-1 had a pH of 3.65 and an estimated flow rate of 20 gpm; sample 07-157-AD-2 had a pH of 3.57 and an estimated flow rate of 8 gpm; and sample 07-158-AD-1 had a p of 6.14 and an estimated flow rate of 25 gpm. The three adit discharges (07-157-AD-1 and 2 a 07-158-AD-1) flowed over the dumps and joined together; a water sample (07-157-SW-1) was collected at the point of confluence and the pH was 4.65. The background soil sample from th Ripple Mines Site (07-163-SS-1) was used for this site because of the proximity of the sites (Pioneer, 1994f). Sample locations are presented in Figure 7 and sample results are presented Table 1.

Antimony, arsenic, barium, cadmium, copper, lead, manganese, mercury, silver, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in waste rock. There was no upstream surface water to compare the downstream surface water (combined adit discharges); however, cadmium exceeded the M and lead exceeded the action level in this sample. There was no upgradient groundwater samp to compare to the adit discharges; however, cadmium exceeded the MCL and lead exceeded th action level in all three adit discharge samples.

2.3.1.6 Emma Mine Site

The Emma Mine Site was sampled in June 1994, by Pioneer for the MDEQ/AMRB. The site slope was approximately 22 degrees. Access to the site was on a maintained dirt road with no restrictions. There were approximately 520 cubic yards of uncovered waste rock in three dum two of the dumps were composited and sampled (07-144-WR-1). The uncontained waste rocl was located in Squaw Creek. Paired surface water and sediment samples were collected upstream and downstream in Squaw Creek (07-144-SW/SE-2 and 1, respectively). The background soil sample from the Ripple Mines Site (07-163-SS-1) was used for this site becaı of the proximity of the sites (Pioneer, 1994g). Sample locations are presented in Figure 8 and sample results are presented in Table 1.

Antimony, arsenic, cadmium, copper, lead, manganese, silver, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in waste rock. There were no compounds elevated in downstream surface water relative to upstream; however, copper and silver were elevated at least three times upstream concentrations in downstream sediment.

2.3.2 1993 MDEQ/AMRB Hazardous Materials Inventory Investigation

2.3.2.1 Big Seven Mine Site

The Big Seven Mine Site was sampled in May 1993, by Pioneer for the MDEQ/AMRB. The slope of the site was approximately 20 to 25 degrees. Access was gained on a maintained road; there was a locked gate. There were approximately 2,580 cubic yards of mostly uncovered tailings in two piles (TP-1 and 2) and one wet impoundment (TP-3) that were composited and sampled (07-156-TP-2, TP-3A, and TP-3B). All tailings were uncontained and in the one-year floodplain of an unnamed tributary of Snow Creek. There were approximately 25,800 cubic yards of uncovered waste rock located in four dumps that were composited and sampled (07-156-WR-1, 2, 3, and 4). The unnamed tributary ran through uncontained waste rock. Other potentially hazardous materials on-site included two empty 300 gallon above ground tanks, assorted lab chemicals, two old transformers which appeared not to have leaked, two 30 gallon drums labelled potassium and amy/xanthate, and one 50 gallon drum with unknown contents. Paired surface water and sediment samples were collected upstream and downstream of the tailings (07-156-SW/SE-1 and 4, respectively). The upstream surface water had a pH of 5.86 and a flow rate of 1.45 cfs, and the downstream surface water had a pH of 4.09 and a flow rate of 0.106 cfs. In addition, a surface water sample (07-156-SW-2) was collected upstream of some of the waste rock, and a sediment sample (07-156-SE-5) was collected below the entire site prior to the confluence with Snow Creek. There was one discharging adit (07-156-SW-3); pH was 6.63 and the flow rate was 0.06 cfs. The adit discharge entered the unnamed tributary. A background soil sample was collected (07-156-SL-1) on-site (Pioneer, 1993a). Sample locations are presented in Figure 9 and sample results are presented in Table 2.

Antimony, arsenic, cadmium, lead, manganese, mercury, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in tailings. Cyanide was not detected in tailings. Antimony, arsenic, cadmium, lead, manganese, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in waste rock. There was no surface water sample upstream of the entire site; however, comparing mid-site surface water and sediment samples (07-156-SW-2/ 07-156-SE-1) to downstream samples (07-156-SW-4/SE-5) showed that iron, nickel, zinc, and manganese were elevated at least three times upstream concentrations in downstream surface water; and barium, mercury, manganese, and nickel were elevated at least three times upstream concentrations in downstream sediment. There was no upgradient groundwater sample to compare with the discharging adit; however, cadmium and nickel (not attributable to the site) exceeded MCLs.

2.3.2.2 Baker Mine Site

The Baker Mine Site was sampled in July 1993, by Pioneer for the MDEQ/AMRB. The site slope was approximately 20 degrees. The site was accessed on a 4WD road with no restrictio There were approximately 420 cubic yards of uncovered waste rock in two dumps that were composited and sampled (07-180-WR-1). The uncontained waste rock was adjacent to two sn unnamed tributaries to Mackay Creek. There were no surface water or sediment samples collected because the site was small in comparison to the Vilipa site discussed in the followin section. The background soil sample from the Silver Dyke Adit Site (07-135-SS-1) was used this site because of the proximity of the two sites (Pioneer, 1993b). Sample locations are presented in Figure 10 and sample results are presented in Table 2.

Antimony, barium, copper, and mercury were elevated at least three times background concentrations or above the detection limit, if background was not detected, in waste rock.

2.3.2.3 Vilipa Mine Site

The Vilipa Mine Site was sampled in July 1993, by Pioneer for the MDEQ/AMRB. The site slope ranged from approximately 3 to 30 degrees. The site was accessed on a 4WD road with restrictions. There were approximately 5,700 cubic yards of mostly uncovered waste rock in dumps that were composited and sampled (07-080-WR-1 and -2). The uncontained waste roc was in Mackay Creek. Paired surface water and sediment samples were collected upstream ar downstream in Mackay Creek (07-080-SW-3/SE-3 and SW-1/SE-1, respectively). The upstre surface water had a pH of 7.69 and a flow rate of 0.03 cfs, and the downstream surface water a pH of 7.61 and a flow rate of 1 cfs. A paired surface water and sediment sample (07-080-S 2/SE-2) was collected in the middle of the site. There was one discharging adit, two filled sha and a seep on-site; however, these were not sampled. A background soil sample from the Sil Dyke Adit Site (07-135-SS-1) was used for this site because of the proximity of the two sites (Pioneer, 1993c). The sample locations are presented in Figure 11 and the sample results are presented in Table 2.

Copper and mercury were elevated at least three times background concentrations or above th detection limit, if background was not detected, in waste rock. Copper and manganese (not attributable to the site) were elevated at least three times upstream concentrations in downstre surface water.

2.3.2.4 Carpenter Creek Tailings Site

The Carpenter Creek Tailings Site was sampled in May 1993, by Pioneer for the MDEQ/AMI The site slope was approximately 5 degrees. Access was by road with no restrictions. There were approximately 111,000 cubic yards of mostly uncovered tailings on-site. The tailings w in two ponds that were composited and sampled (07-103-UT-1 and -2 and 07-103-LT-1 and - The uncontained tailings were in the one-year floodplain of Carpenter Creek. Paired surface water and sediment samples were collected upstream and downstream of the site in Carpente

Creek (07-103-SW/SE-5 and 3, respectively). The upstream surface water had a pH of 8.7, and downstream surface water had a pH of 6.4. In addition, paired surface water and sediment samples were collected in Carpenter Creek between the upper and lower tailings ponds (07-103-SW/SE-4) and just prior to the confluence with Snow Creek (07-103-SW/SE-1). The background soil sample from the Silver Dyke Adit Site (07-135-SS-1) was also used for this site because of the proximity of the two sites (Pioneer, 1993d). The sample locations are presented in Figure 12 and the sample results are presented in Table 2.

Antimony, arsenic, barium, cadmium, copper, lead, manganese, mercury, and zinc were elevated at least three times background concentrations or above the detection limit, if background was not detected, in tailings. There were no concentrations in downstream surface water that were elevated at least three times greater than upstream concentrations; however, arsenic, barium, and lead were elevated at least three times upstream concentrations in downstream sediment.

2.3.2.5 Silver Dyke Mill Site

The Silver Dyke Mill Site was sampled in May 1993, by Pioneer for the MDEQ/AMRB. The site slope was approximately 30 degrees. The site was accessed on a 4WD road with no restrictions. There were approximately 82,600 cubic yards of uncovered waste rock in five dumps which were composited and sampled (07-138-WR-1 and 2 and 07-138-TP-1). The uncontained waste rock was not in any floodplain of Squaw Creek; hence, no surface water or sediment samples were collected. The background soil sample from the Silver Dyke Adit Site (07-135-SS-1) was also used for this site because of the proximity of the two sites (Pioneer, 1993e). The sample locations are presented in Figure 13 and the sample results are presented in Table 2.

Arsenic, barium, cadmium, copper, lead, manganese, mercury, and zinc were elevated at least three times above background concentrations or above the detection limit, if background was not detected, in waste rock.

2.3.2.6 Silver Dyke Tailings Site

The Silver Dyke Tailings Site was sampled in May 1993, by Pioneer for the MDEQ/AMRB. The site slope ranged from 28 to 40 degrees. The site was accessed on a maintained road with no restrictions. There were approximately 56,350 cubic yards of uncovered tailings in six piles which were composited and sampled (07-137-TP-1, -2, and -6). The uncontained tailings were in the one-year floodplain of Carpenter Creek and an unnamed tributary. Paired surface water and sediment samples were collected upstream and downstream in Carpenter Creek (07-137-SW-3/SE-3 and SW-4/SE-4, respectively). In addition, paired surface water and sediment samples were collected upstream and downstream in an unnamed tributary that flows through the site (07-137-SW-1/SE-1 and SW-2/SE-2, respectively). The background soil sample from the Silver Dyke Adit Site (07-135-SS-1) was used for this site because of the proximity of the two sites (Pioneer, 1993f). The sample locations are presented in Figure 14 and the sample results are presented in Table 2.

Arsenic, barium, cadmium, copper, lead, manganese, and mercury were elevated at least three times background or above the detection limit, if background was not detected, in tailings. Copper, lead, manganese, and zinc (not attributable to the site) were elevated at least three tim upstream concentrations or above the detection limit, if background was not detected, in downstream Carpenter Creek surface water. Arsenic, barium, cadmium, copper, lead, manganese, mercury, and zinc (not attributable to the site) were elevated at least three times upstream concentrations or above the detection limit, if background was not detected, in downstream Carpenter Creek sediment.

Copper, iron (not attributable to the site), lead, manganese, and zinc (not attributable to the site were elevated at least three times upstream concentrations or above the detection limit, if background was not detected, in the downstream unnamed tributary surface water. Arsenic, barium, copper, lead, manganese, and zinc (not attributable to the site) were elevated at least three times upstream concentrations or above the detection limit, if background was not detect in downstream unnamed tributary sediment.

2.3.2.7 Silver Dyke Adit Site

The Silver Dyke Adit Site was sampled in June 1993, by Pioneer for the MDEQ/AMRB. The site slope was approximately 28 degrees. The site was accessed on a 4WD road with no restrictions. There were approximately 12,100 cubic yards of uncovered waste rock in two dumps which were composited and sampled (07-135-WR-1 and 2). The uncontained waste ro was within the flow path of the adit discharge which made up all the flow in Squaw Creek at t point. Paired surface water and sediment samples were collected after the adit discharge flow over a dump (07-135-SW-2/SE-2). In addition, paired surface water and sediment samples we collected further downstream on Squaw Creek (07-135-SW-3/SE-3 and SW-4/SE-4). There w one discharging adit on-site (07-135-SW-1); the pH was 5.12 and the estimated flow rate was cfs. There was a residential drinking water well approximately 1,000 feet from the site. The w (07-135-GW-1) had a total depth of 260 feet and a pH of 7.43. A background soil sample (07-135-SS-1) and a duplicate well sample (07-135-GW-2) were collected at this site (Pioneer, 1993g). The sample locations are presented in Figure 15 and the sample results are presented Table 2.

Antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc were elevated least three times background concentrations or above the detection limit, if background was n detected, in waste rock. There was no upstream surface water to compare to downstream surf water. There was no upgradient groundwater to compare to the adit discharge or well. There were no MCLs exceeded in the drinking water well. The MCLs for antimony, cadmium, and nickel and the action levels for copper and lead were exceeded in the adit discharge.

2.3.2.8 Sherman No. 2 (Southwest) Site

The Sherman No. 2 (Southwest) Site was sampled in May 1993, by Pioneer for the MDEQ/AMRB. The Sherman No. 2 (Northeast) Site (only an adit) was investigated with this site. The site slope was approximately 30 degrees. The site was accessed by foot over a short trail from the main road with no restrictions. There were approximately 200 cubic yards of uncovered waste rock in two dumps. The waste rock was not submitted to the lab for analysis because of the small volume although Burg Creek was adjacent to the dump. Surface water field parameters were measured above and below the site in Burg Creek. The upstream surface water pH was 7.5 and the downstream surface water pH was 7.26; no samples were collected for lab analysis. There was one discharging adit on-site which entered Burg Creek; there was no sample submitted to the lab. The adit discharge pH was 7.1, and the flow rate was estimated at less than one gpm (Pioneer, 1993h). The site sketch is presented in Figure 16.

2.3.3 1990 MDEQ/AMRB Environmental Assessment

Samples were collected as part of an environmental assessment for the Neihart Mining District by MSE, Inc., of Butte, Montana, for the MDEQ/AMRB in the fall of 1990. There was no sampling and analysis plan for the investigation; hence, quality control, sample methods, and lab methods are unknown. Surface water sample results are presented in Table 3 and source sample results are presented in Table 4.

2.3.4 MDEQ/WQB - 1973 Water Quality Sampling

The MDEQ/Water Quality Bureau (WQB) collected data for surface water in Belt Creek sampled from 1973 to 1980. There is no information regarding sampling methods, specific sampling locations, or data quality. The analyses are for total recoverable metals; the analyses method is unknown. Reported data had the following ranges:

<u>BELT CREEK BELOW CONFLUENCE WITH DRY FORK BELT CREEK</u>

Al	=	<0.1 to 1 ppm
Cd	=	<0.005 to 0.005 ppm
Cu	=	<0.01 to 0.02 ppm
Fe	=	0.01 to 0.94 ppm
Pb	=	0.01 ppm
Mn	=	0.01 to 0.42 ppm
Hg	=	<0.0002 ppm
Ag	=	<0.01 to <0.05 ppm
Se	=	<0.001 ppm
Zn	=	0.04 to 0.73 ppm

<u>BELT CREEK ABOVE NEIHART</u>

As	=	<0.01 ppm
Cd	=	<0.01 ppm
Cu	=	<0.01 to 0.04 ppm
Fe	=	0.01 to 0.22 ppm

Pb = <0.01 to 0.02 ppm
Zn = <0.01 to 0.05 ppm

Concentrations of metals in Belt Creek below the confluence with Dry Fork Belt Creek are ab(the detection limit for iron, lead, manganese, and zinc (MDEQ/WQB, 1980).

2.4 DATA SUMMARY

The data collected as part of the 1994 and 1993 MDEQ/AMRB Hazardous Materials Inventor investigations were collected under a Sampling and Analysis Plan (Pioneer, 1994h and Pionee 1993i) and a Quality Assurance Project Plan (Pioneer, 1994i and Pioneer, 1993j) that included proper EPA sampling procedures and quality assurance/quality control (QA/QC). The data we determined acceptable for use with some limitations according to EPA guidance (Pioneer, 199 and Pioneer, 1994a). The data collected in 1990 by MSE, Inc., for the MDEQ/AMRB and the data collected by the MDEQ/WQB have little or no information regarding sampling protocols. decontamination, chain-of-custody, analysis methods, sample locations, field QA/QC samples data validation. These data must be considered unvalidated and be used for screening purpose only.

2.5 SITE BACKGROUND

2.5.1 Population

There are no workers or residents on any potential source (Pioneer, 1994b through g and Pion(1993a through h). A residence exists 1,000 feet from the Silver Dyke Adit Site (Pioneer, 199: The number of residences within four-miles of the site was estimated using the Lewis and Cla National Forest Map (USFS, 1988). The center of the four-mile radius was the confluence of Snow Creek and Carpenter Creek (downgradient of all potential sources). There are 2.6 perso per residence in Cascade County (Census, 1990). Using the two previously mentioned source there are no residences within 0 to 0.25 mile of the site; approximately 2.6 reside within 0.25 0.50 mile of the site; there are no residences within 0.50 to 1.0 mile of the site; approximately 33.4 people reside within 1.0 to 2.0 miles of the site; approximately 54 people reside within 2. to 3.0 miles of the site; and approximately 10.3 people reside within 3.0 to 4.0 miles of the sit

2.5.2 Soils and Geology

The Lewis and Clark National Forest soil scientist reports that the soils in the area have not be classified; however, the soils of the floodplain of Snow and Carpenter Creeks are probably fluvents and borolls and the soils of the hillsides are probably Aquic Cryoboralfs. The fluven and borolls occur on floodplains and associated terraces and alluvial fans. Vegetation is varia and ranges from spruce-fir forest to fescue grasslands; cottonwood and aspen are often includ The soils form in texturally stratified alluvial deposits and are deep, well or moderately well drained, and frequently calcareous. They contain deep, fluctuating water tables which subirri; shrub and forest vegetation. The Aquic Cryoboralfs are very old clayey alluvial or glacial deposits on gently sloping mountain ridges which support Lodgepole pine forest on Alpine fir or spruce/dwarf huckleberry habitat types. The unit occurs at elevations of 5,500 to 6,500 feet above sea level (USFS, 1995).

The geology of the Little Belt Mountains was mapped by the U.S. Geological Survey. The general structure of the Little Belt Mountain Range is a broad dome-shaped uplift. Sedimentary rocks near the summit of the dome are nearly horizontal; those on the northern and eastern flanks dip steeply towards the plains. Numerous laccolithic domes obscure the simple folds of the uplift by further deforming the sedimentary beds, particularly about the margin of the range and immediately beyond it (Weed, 1900). The area is underlain by the intrusive Carpenter Creek and Snow Creek porphyrys; pre-Beltian, Precambrian, quartzose gneiss; Neihart quartzite (Beltian); and the Pinto diorite.

The topography of the site is mountainous ranging in elevation from 5,900 to 7,820 feet with a steep slope ranging from 15 to 35 degrees (Pioneer, 1994b through g and 1993a through h).

2.5.3 Hydrogeology and Hydrology

The groundwater in the floodplain parts of the area is estimated at less than 25 feet below ground surface (bgs; Pioneer, 1994b through g and Pioneer, 1993a through h). There are no published reports about groundwater in the vicinity of the site.

According to the Montana Bureau of Mines and Geology's (MBMG) well log database and on-site visits, there are 11 wells within a four-mile radius of the site. Although the potential sources are located throughout the drainage basin, the four-mile radius was calculated from the confluence of Snow Creek and Carpenter Creek (downgradient of all the sources). The wells within the 4-mile radius include none within the 0 to 0.25 mile radius, one within the 0.25 to 0.50 mile radius, none within the 0.50 to 1.0 mile radius, none within the 1 to 2 mile radius, 3 within the 2 to 3 mile radius, and 7 within the 3 to 4 mile radius (MBMG, 1994). Well depths range from 14 feet to 120 feet and static water levels ranged from 6.3 feet to 24 (MBMG, 1994). There is no wellhead protection area (WHPA) designated in the vicinity (MDEQ/WQB, 1995).

Carpenter Creek flows northeast to the west and then southwest; tributaries include Lucy Creek, Haystack Creek, Mackay Creek, Burg Creek, Snow Creek, and Squaw Creek. It is approximately five miles from the headwaters of Carpenter Creek to the confluence with Belt Creek. Belt Creek then flows into the Missouri River 70 miles downstream. There are no fisheries data available for Carpenter Creek, but fisheries data are available for Belt Creek. The Montana Department of Fish, Wildlife, and Parks (MDFWP) evaluated Belt Creek in four segments: Jefferson Creek to 0.3 mile below the confluence with Dry Fork Belt Creek (a 15.9 mile segment); 0.3 mile below the confluence with Dry Fork Belt Creek to Riceville (a 14.3 mile segment); Riceville to the confluence with Big Willow Creek (a 25.9 mile segment); and the confluence with Big Willow Creek to the mouth (a 21.2 mile segment). The first two segments are applicable to the HRS evaluation for this site. From Jefferson Creek (approximately 4.5 miles upstream of the confluence with Carpenter Creek) to 0.3 mile downstream of the confluence with Dry Fork Belt

Creek (approximately 12 miles downstream of the confluence with Carpenter Creek), the MDFWP reports a trout biomass of 11 pounds per 1,000 feet with 69 fishing days per year per mile. From 0.3 mile downstream of the confluence with Dry Fork Belt Creek to the Riceville Bridge, the MDFWP reports a trout biomass of 22 pounds per 1,000 feet and 69 fishing days p year per mile. Rainbow Trout and Mountain Whitefish are common species (MDFWP, 1977).

Recreation on Belt Creek is reported by the MDFWP to include fishing camping, swimming, a boating (MDFWP, 1977). The Montana Department of Natural Resources and Conservation (DNRC) reports surface water rights have been filed for the following purposes from the headwaters of Carpenter Creek to 15 miles downstream: stock; exploratory drilling; mining; f and wildlife; irrigation; and domestic. The domestic use was reported in Sections 14 and 25 o Township 15 North and Range 7 East (DNRC, 1995).

2.5.4 Meteorology

The 2-year 24-hour rainfall at the site is 2.2 inches (NOAA, 1973). The average annual precipitation at Neihart, based on precipitation data from 1967 to 1994, is 21.92 inches (Climatedata, 1995).

2.5.5 Sensitive Environments

According to the wildlife assessment prepared by the MDFWP, there are no threatened or endangered species present in the Belt Creek drainage (MDWFP, 1977). Wetlands have not b delineated along Carpenter Creek; however, it appears wetlands exist at least 15 miles downstream along Belt Creek.

3.0 SITE EVALUATION

3.1 SOURCE CHARACTERIZATION

The source characterization performed by Pioneer for the MDEQ/AMRB is fairly adequate for use for the SI. It is recommended to perform additional source characterization sampling at fo of the seven uncharacterized mine sites listed in Section 3.1 (IXL-Eureka, Benton, Cornucopia and Haystack Creek mine sites) since they may contribute contaminants to the surface water pathway. Sampling would involve collecting composited source samples (waste rock) and adi discharge samples if appropriate. An additional background soil sample would also be collect

3.2 CONTAMINANT PATHWAYS

3.2.1 Surface Water

Most of the individual tributaries (Mackay, Squaw, and Snow Creeks) have been sampled upstream and downstream of potential sources. Also, Carpenter Creek has been sampled upstream and downstream of the Silver Dyke and Carpenter Creek Tailings Sites. However, Carpenter Creek has not been sampled downstream of the confluence of Snow Creek and Belt Creek has not been sampled downstream of its confluence with Carpenter Creek. Additional surface water sampling will necessarily involve resampling some of the stations previously sampled by MDEQ/AMRB so that all surface water samples from the drainage are collected during the same hydrologic conditions and temporal variation is minimized.

It is recommended to collect seven surface water samples: a background sample in Carpenter Creek, upstream from the Silver Dyke Tailings site; two samples in Carpenter Creek, upstream and downstream of the confluence with Snow Creek; a sample in Snow Creek just upstream of the confluence with Carpenter Creek; a sample in Carpenter Creek just prior to the confluence with Belt Creek; and two samples in Belt Creek, upstream and downstream of the confluence with Carpenter Creek. Each of the above surface water samples should be paired with sediment samples.

3.2.2 Groundwater

Only one existing residential well, located 1,000 feet from the Silver Dyke Adit Site, has been sampled in the Carpenter Creek drainage. This well sample did not exceed any MCLs. However, the MBMG database identified two wells located downgradient of the confluence of Snow and Carpenter Creeks. A residence was observed along Carpenter Creek downstream of the confluence.

It is recommended to sample additional downgradient existing residential wells (at least the one observed and possibly a recreational well) and an appropriate upgradient well (a Neihart well may be suitable).

3.2.3 Air

There has been no air sampling at this site. There are no residences within 200 feet that might be susceptible to fugitive dust. Air sampling is not recommended since most of the site is remote from residential populations and is within rugged topography that severely limits dust migration.

3.2.4 Soil

The soil exposure route can be adequately addressed with source characterization data.

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III. SAMPLING ACTIVITIES

1.0 FIELD SAMPLING

Field sampling was performed on July 31 and August 1, 1995, by Meg Babits, Julie Flammang, and Dave Tuesday of Pioneer. Ms. Denise Martin of the MDEQ/ERD/Superfund Program was present for the sampling activities on July 31, 1995. Groundwater, soil, mine waste, sediment, and surface water samples were collected at the site. Sample locations are illustrated on Figure 17. A summary of all samples collected is presented in Tables 5 through 8; field parameters for surface water and groundwater samples are summarized in Table 9. A copy of the field logbook kept during the sampling activities and copies of the chain-of-custody forms are contained in Appendix D. A preliminary wetlands inventory was performed and results are presented in Appendix E. The photographs of the site are presented in Appendix F (photos are copies of those collected during a MDEQ/AMRB investigation). All sampling was conducted using EPA approved methods (EPA, 1987) and followed the approved Sampling and Analysis plan for the site, with the changes outlined later in this report.

1.1 <u>SURFACE WATER AND SEDIMENT SAMPLES</u>

Surface water sampling was performed at four locations on Carpenter Creek, one location on Snow Creek, and three locations on Belt Creek. Stream sediment samples were collected at the same locations as the surface water locations. The samples were collected in the following order: CC-SW/SD-8, 7, 6, 5, 4, 3, 2, and 1, (moving upstream) to avoid disturbing sediments and contaminating downstream samples.

Surface water samples were collected by submerging the sample containers directly into the flowing creek, with the opening facing upstream. Surface water field parameters (pH, SC, and temperature) were measured and flow was estimated. Samples were collected for total metals analyses. Surface water samples are summarized in Table 5 and field parameters are listed in Table 9.

Sediment samples were collected by grabbing available sediment from the active part of the creek with a stainless steel spoon and placing the sediment directly into the appropriate containers. Sediment samples were collected for total metals analyses. Sediment samples are summarized in Table 6.

Sample CC-SW/SD-1 was collected approximately one mile upstream of the confluence of Squaw Creek in Carpenter Creek. There were no indications of mining activity in the area. Sample CC-SW/SD-2 was collected in Carpenter Creek immediately prior to the confluence with Snow Creek; tailings were apparent in the creek bed. Sample CC-SW/SD-3 was collected in Snow Creek approximately 35 feet upstream of the confluence with Carpenter Creek. Sample CC-SW/SD-4 was collected at the probable point of entry (PPE) in Carpenter Creek. The location was just below the confluence of Snow Creek, downstream from all potential sources. The creek bed had red staining on the rocks.

Sample CC-SW/SD-5 was collected in Carpenter Creek 100 feet upstream of the confluence v Belt Creek. Sample CC-SW/SD-6 was collected 100 feet upstream of the confluence with Carpenter Creek in Belt Creek. Sample CC-SW/SD-7 was collected in Carpenter Creek approximately 32 feet downstream of the confluence with Carpenter Creek. Sample CC-SW/S 8 was collected in Belt Creek approximately nine miles downstream of the confluence of Carpenter Creek, just upstream of the town of Monarch.

1.2 GROUNDWATER SAMPLES

Six groundwater samples were collected at the site. All groundwater samples were collected f total metals. Groundwater samples are summarized in Table 7.

Sample CC-GW-1 was collected from a spring located in the south end of Neihart. The sprin was exiting a PVC pipe behind a residence and is used for domestic supply. Sampling was frc the pipe directly into the bottle. Sample CC-GW-2 was collected from an existing residential well along Carpenter Creek Road. The total depth of the well was approximately 43 feet belo ground surface (bgs). The well produced only 4 to 5 gallons per minute according to the owne The well had been used during the day, and 15 gallons of water was purged prior to sampling. The owner previously had the well tested for selected metals and cyanide; nothing was detecte Sampling was from the tap at the well head directly into the bottle.

Sample CC-GW-4 was collected from a discharging open (five feet by four feet) adit at the IX Eureka Mine Site; the rocks in the drainage away from the adit were stained orange. The adit discharge reached an unnamed tributary of Snow Creek. Sample CC-GW-5 was collected fro collapsed discharging adit at the Ontario Mine Site. The adit discharge flowed over the dump but did not appear to enter a drainage channel. Sample CC-GW-7 was collected from a collap discharging adit at the Cornucopia Mine Site. The adit discharge flowed over the dump and i an unnamed tributary of Snow Creek. Sample CC-GW-8 was collected from a collapsed discharging adit at an unnamed mine site below the Haystack Creek Mine Site. The adit discharge ran into Haystack Creek; the rocks were stained red.

1.3 SOIL SAMPLES

Eleven soil samples were collected at the site. All soil samples were collected with stainless steel spoons directly into the appropriate sample containers. All soil samples were analyzed f total metals. Soil samples are summarized in Table 8.

The background soil sample (CC-SS-1) was collected as a depth composite sample from surfa to six inches. The sample was located 150 feet upstream on Carpenter Creek from the background surface water sample and on the southern hillside. The area appeared to have no impacts from mining.

Samples CC-SS-2 and 3 were waste rock samples collected at the IXL-Eureka Mine Site. There were approximately 80 cubic yards of waste rock in the dump (Upper West Eureka) from which sample CC-SS-2 was collected; the dump was in the drainage. Sample CC-GW-4 was collected at this adit discharge (see Section 1.2). There was abundant pyrite in this dump. Another open adit and smaller dump (Lower West Eureka) existed below this dump (approximately 150 cubic yards) in the drainage; no sample was collected. There were approximately 100 cubic yards of waste rock in the dump from which sample CC-SS-3 was collected; the dump was not in the drainage. The adit was collapsed and was up the hillside, east of the Upper West Eureka.

Samples CC-SS-4 and 12 were waste rock samples collected at the Cornucopia-Ontario Mine Site. There were approximately 250 cubic yards of waste rock in the dump (Ontario) from which sample CC-SS-4 was collected; the dump was in the drainage. Sample CC-GW-5 was collected at the adit discharge at this dump (see Section 1.2). There were approximately 750 cubic yards of waste rock in the dump (Cornucopia) from which sample CC-SS-12 was collected; the dump was in the drainage and an adit discharge was sampled here (CC-GW-7). The tributary flow rate was estimated at 20 gallons per minute (gpm) and there was a 30 foot highwall associated with this dump. There was a second dump (approximately 1,600 cubic yards) located to the south that was part of the Cornucopia; however, this dump was 90 feet from the drainage and was not sampled. There was a collapsed shaft associated with this southern dump.

Samples CC-SS-6 and 7 were waste rock samples collected at the Benton (Big Snowy) Mine Site. There were approximately 250 cubic yards of waste rock in the dump (Upper Big Snowy) from which sample CC-SS-6 was collected; the dump was in a dry drainage. There was a collapsed adit with some standing water (not sampled). There were approximately 6,500 cubic yards of waste rock in the dump (Lower Big Snowy) from which sample CC-SS-7 was collected; the dump was in a dry drainage. There was a collapsed adit with standing water; a 25 foot highwall was associated with this adit.

Sample CC-SS-8 was a waste rock sample collected at the Haystack Creek Mine Site. The dump, approximately 25 cubic yards, was in the creek. The adit associated with the dump was collapsed with some water ponded outside of it, but it was not flowing and was not sampled.

Sample CC-SS-9 was a waste rock sample collected at an unnamed mine site approximately one mile south of the Haystack Creek Mine Site. There were two dumps, approximately 750 cubic yards total, associated with two collapsed adits; both were in Haystack Creek. One adit was discharging and was sampled (see Section 1.2).

Samples CC-SS-10 and 11 were waste rock collected at the Black Diamond Jay Mine Site. Both samples were collected at the dump at the Lower Black Diamond Jay Mine Site. There were approximately 8,100 cubic yards of material in the dump; the toe of the dump was 15 feet from an unnamed tributary of Snow Creek, which flowed at approximately 55 gpm. There was a small seep at the base of the dump. There was a collapsed discharging adit associated with this dump that was not sampled because of the very low flow rate (approximately 1.5 gpm). A metal boiler and wooden buildings were associated with this site. There were sulfide minerals and quartz in this dump. A shaft and dump (approximately 30 cubic yards) at the Black Diamond Jay Mine Site were located above the Lower Black Diamond Jay Mine Site. This dump was not sample‹ because it was not in the drainage and it was very small.

1.4 QA/QC SAMPLES

All QA/QC procedures, including sampling methods, sample preservation, equipment decontamination, and chain-of-custody strictly followed EPA protocols (EPA, 1987). A logbo was kept, recording activities and measurements pertinent to the investigation. Preservation o samples was performed immediately upon sample collection.

Three QA/QC samples were collected for water: one field duplicate of CC-GW-2 (CC-GW-6) one rinsate of soil equipment (CC-SW-9), and one on-site bottle blank (CC-SW-10). There w: no equipment used for collecting water samples; therefore, no QA/QC sample was collected to assess equipment decontamination procedures.

2.0 POST-SAMPLING

Because samples collected during an investigation could be used as evidence in litigation, EP chain-of-custody procedures were followed. These procedures keep the samples traceable fror the time they are collected. All sample containers were tagged, identified, and custody seals w placed on all shipping containers. The samples were recorded in the field logbook and on the chain-of-custody forms.

All samples for analyses were shipped via Federal Express from Butte, Montana, on August 3, 1995, to:

Quanterra Environmental Services, Inc., Earth City, MO.

The case number for all analyses was 23851. All shipping was done in accordance with the regulations issued by the Department of Transportation in 49 Code of Federal Regulations Par 171 through 178.

3.0 FIELD OBSERVATIONS

Significant observations during the site inspection include the following:

- The nearest residence and the nearest well were located at the head of Squaw Creek, 1,000 feet from the Silver Dyke Adit Site; this well was sampled in 1993 for the MDEQ/AMRB. The well sampled as CC-GW-2 in 1995 for the SI was approximately 2,000 feet from the confluence of Carpenter and Snow Creeks.

- The residence at CC-GW-2 sample location was year-round. There were four seasonal homes on Carpenter Creek Road.

- A total of approximately 41 acres of wetlands were observed from the base of the Carpenter Creek Tailings Site 15 miles downstream. The wetlands were not contiguous, but located in 11 different isolated locations. The total river front miles of wetlands is 3.75 (see Appendix E).

- The town of Neihart receives its drinking water from a reservoir on O'Brien Creek, southwest of the town.

- There are two homes in Neihart that have wells; the rest receive water from the reservoir.

4.0 PROBLEMS/CHANGES

There were no unforeseen problems associated with sampling at the Carpenter and Snow Creek Mining Complex Site. However, changes made to the Sampling and Analysis Plan are described below.

- The residence at CC-GW-2 had only one well as opposed to the two reported by the MBMG; hence, no CC-GW-3 was collected.

- An adit discharge was found at both the Cornucopia and Ontario Mine Sites (only one was planned), so an additional groundwater sample was added.

- An adit discharge was found at the unnamed mine site on Haystack Creek. The adit discharge was added to the groundwater samples.

- The sample number, CC-SS-5, was planned to be used at the Cornucopia Mine Site. In the field, personnel did not believe the dump sampled was the Cornucopia and CC-SS-5 was eliminated and an alternate sample number was generated (CC-SS-12) for the waste rock. However, upon closer examination of files, the dump (CC-SS-12) was the Cornucopia.

- Sample CC-SS-9 was collected at the unnamed mine south of the Haystack Creek Mine Site instead of at the Haystack Mine Site because the southern mine was larger.

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IV. ANALYTICAL RESULTS

1.0 ANALYTICAL DATA QUALITY

Prior to interpretation of analytical data, the quality and limitations of the data must be evaluated. Both field generated QA/QC analyses and laboratory generated QA/QC analyses are considered.

Copies of all the laboratory analytical data generated from the site inspection are included in Appendix H. Copies of the data validation results are presented in Appendix I.

1.1 FIELD QA/QC SAMPLES

Three QA/QC samples were collected in the field during this site inspection: a duplicate of CC-GW-2 (CC-GW-6), a soil equipment rinsate sample (CC-SW-9), and a bottle blank sample (CC-SW-10). All QA/QC samples were analyzed for total metals. Table 10 presents the surface water and QA/QC sample results.

Sample CC-GW-6 duplicated sample CC-GW-2, the downgradient well sample. Several analytes were not within the 20% relative percent difference (RPD) for water samples. The 20% control limit for the RPD is borrowed from the Contract Lab Program (CLP) Statement of Work (SOW) for RPDs for the matrix spike and the matrix spike duplicate. The following analytes were outside the control limit: barium (21%), copper (101%), lead (38%), manganese (21%), and vanadium (54%). Although no flag will be applied based on a field QA/QC sample, the copper RPD result is considered significant and should be considered when evaluating copper data (it would be unknown whether copper data are biased high or low).

Aluminum (30.1B ppb), barium (3.6B ppb), beryllium (0.54B ppb), copper (7.8B ppb), iron (44.2B ppb), manganese (3.5B ppb), selenium (3.9B ppb), thallium (4.5B ppb), and zinc (9.4B ppb) were all detected in the soil equipment rinsate sample (CC-SW-9). All the analytes were detected at levels less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL), hence, the "B" flag. While the number of contaminants is significant, the levels are not significant. There are no flags applied because of the analytes detected in the equipment rinsate sample.

Aluminum (32.9B ppb), copper (7.7B ppb), iron (42.2B ppb), manganese (3.5B ppb), and zinc (11.9B ppb) were all detected in the bottle blank sample (CC-SW-10). All the analytes were detected at levels less than the CRDL but greater than the IDL, hence, the "B" flag. While the number of contaminants is significant, the levels are not significant. There are no flags because of the analytes detected in the field blank sample.

1.2 LAB QA/QC SAMPLES

The soil and water inorganic data received result qualifiers from the laboratory. The qualifier: appear in the appropriate data tables and are explained with footnotes to the table. The soil ar water inorganic data were also screened by a data reviewer after receipt from the laboratory ar additional data qualifiers were applied (see Appendix I); these data qualifiers also appear in th appropriate data tables and are explained with footnotes to the table.

For soil samples, the preparation and continuing calibration blanks had elevated levels of magnesium, vanadium, and beryllium. The magnesium levels in samples CC-SS-3 and 9, the vanadium levels in samples CC-SS-1, 10, and 3, and the beryllium levels in samples CC-SD-: and 5 were overestimated because these analytes were found in the blanks. The detects shoulc considered nondetects ("U" flag). The digestion spike for copper was out of the control limit: however, no qualification was needed.

For water samples, the continuing calibration blanks had elevated levels of barium and berylli The barium and beryllium levels in samples CC-SW-9 and 10 were overestimated because the analytes were found in the blanks. The detects should be considered nondetects ("U"flag).

2.0 DISCUSSION OF SITE ANALYTICAL DATA

2.1 SURFACE WATER/SEDIMENT SAMPLES

Eight surface water and sediment samples were collected during this site inspection: four in Carpenter Creek, one in Snow Creek, and three in Belt Creek (Figure 17). Sample CC-SW-1/SD-1 was collected upstream in Carpenter Creek above any obvious mining impacts. Samp CC-SW-2/SD-2 was collected in Carpenter Creek just prior to the confluence with Snow Cree Sample CC-SW/SD-3 was collected in Snow Creek just prior to the confluence with Carpente Creek. Sample CC-SW/SD-4 was collected in Carpenter Creek just below the confluence wit Snow Creek; this represented the probable point of entry (PPE) because it was downgradient (all mines. Sample CC-SW/SD-5 was collected in Carpenter Creek just prior to the confluenc with Belt Creek. Sample CC-SW/SD-6 was collected in Belt Creek just upstream of the confluence with Carpenter Creek. Sample CC-SW/SD-7 was collected in Belt Creek just downstream of the confluence of Carpenter Creek. Sample CC-SW/SD-8 was collected in Be Creek just above Monarch, Montana. Table 10 presents the sampling results for surface wate: and Table 11 presents the sampling results for sediment. Elevated levels (at least three times background concentration or above the detection limit, if background was not detected) of me in downstream surface water and sediment samples and upstream levels of those compounds : presented in Figure 18.

Six analytes were elevated in Carpenter Creek surface water: cadmium, copper, iron, lead, manganese, and zinc. Surface water sample CC-SW-2 had elevated cadmium (9.8 ppb), copp (109 ppb), lead (24.1 ppb), manganese (911 ppb), and zinc (1,480 ppb). Surface water sampl

CC-SW-4 had elevated cadmium (7.7 ppb), copper (94.2 ppb), iron (185 ppb), lead (22.8 ppb), manganese (763 ppb), and zinc (1,470 ppb). Surface water sample CC-SW-5 had elevated cadmium (3.9B ppb), copper (58.9 ppb), lead (12.5 ppb), manganese (485 ppb), and zinc (1,010 ppb). Sample CC-SW-2 was compared to CC-SW-4 to evaluate the impact of Snow Creek on Carpenter Creek water quality. There were no metals elevated (at least three times upstream concentrations) in surface water downstream (CC-SW-4) of the confluence of Snow Creek in Carpenter Creek when compared to levels upstream (CC-SW-2) of the confluence of Snow Creek.

Two analytes were elevated in Belt Creek surface water: lead and vanadium. Surface water sample CC-SW-7 had elevated lead (2.4B ppb) and vanadium (5.5B ppb). Surface water sample CC-SW-8 had elevated lead (3.0 ppb) and vanadium (4.8B ppb). The freshwater aquatic water quality criteria (AWQC) for the surface water pathway for cadmium, copper, lead, and zinc were exceeded in all sample locations.

Nine analytes were elevated in Carpenter Creek sediment: arsenic, barium, cadmium, copper, lead, manganese, nickel, silver, and zinc. Arsenic was elevated in sediment samples CC-SD-2 (60.3 ppm), 4 (31.6 ppm), and 5 (36.6 ppm). Barium was elevated in sediment samples CC-SD-2 (640 ppm) and 5 (538 ppm). Cadmium was elevated in sediment samples CC-SD-2 (21.6* ppm), 4 (18.9* ppm), and 5 (15.1* ppm). Copper was elevated in sediment samples CC-SD-2 (3,840N* ppm), 4 (334N* ppm), and 5 (2,350N* ppm). Lead was elevated in sediment samples CC-SD-2 (7,700* ppm), 4 (1,030* ppm), and 5 (4,450* ppm). Manganese was elevated in sediment samples CC-SD-2 (5,080 ppm), 4 (5,430 ppm), and 5 (4,020 ppm). Nickel was elevated in sediment sample CC-SD-4 (42 ppm). Silver was elevated in sediment samples CC-SD-2 (49.5 ppm), 4 (7.8 ppm), 5 (27.8 ppm). Zinc was elevated in sediment samples CC-SD-2 (2,430 ppm), 4 (2,760 ppm), and 5 (1,990 ppm). Sample CC-SD-2 was compared to CC-SD-4 to evaluate the impact of Snow Creek on Carpenter Creek water quality. Nickel and vanadium were both elevated (at least three times the upstream concentration) in sediment downstream of the confluence of Snow Creek in Carpenter Creek.

Four analytes were elevated in Belt Creek sediment: arsenic, copper, manganese, and vanadium. Sample CC-SD-7 had elevated arsenic (48.9 ppm) and manganese (13,900 ppm), and sample CC-SD-8 had elevated copper (310N* ppm) and vanadium (65.1 ppm).

Snow Creek was sampled prior to its confluence with Carpenter Creek to evaluate its contribution to Carpenter Creek elevated metals levels. The contribution of metals was evaluated based on the Snow Creek sample (CC-SW/SD-3) being elevated at least three times upstream Carpenter Creek concentrations (CC-SW/SD-1) or above the detection limit, if upstream concentrations were not detected and the Snow Creek sample being elevated above the Carpenter Creek PPE sample (CC-SW/SD-4). There were no analytes in surface water that met these conditions. In sediment, arsenic, barium, cadmium, manganese, nickel, silver, and zinc met the conditions.

2.2 GROUNDWATER SAMPLES

Six groundwater samples were collected during this site inspection: one spring, one domestic well, and four discharging adits. Sample CC-GW-1 was collected from a spring at a residence located in Neihart, representing upgradient conditions. Sample CC-GW-2 was collected from well at a residence on Carpenter Creek Road, representing downgradient conditions. Sample CC-GW-4 was collected from a discharging adit at the IXL-Eureka Mine Site. Sample CC-GW-5 was collected from a discharging adit at the Ontario Mine Site. Sample CC-GW-7 was collected from a discharging adit at the Cornucopia Mine Site. Sample CC-GW-8 was collecte from a discharging adit at an unnamed mine on Haystack Creek. Groundwater total metals sampling results are presented in Table 12. Elevated levels of total metals in the downgradient groundwater well sample and the adit discharges, and upgradient levels of those metals, are presented in Figure 18.

Twelve analytes were elevated at least three times upgradient concentrations or above the detection limit, if upgradient concentrations were not detected in groundwater. Groundwater sample CC-GW-2 and its duplicate CC-GW-6 had elevated levels of copper (75.7 ppb; GW-6), iron (323 ppb; GW-6), manganese (11.2B and 13.9B ppb, respectively), and vanadium (4.1B a 7.2B ppb, respectively). Groundwater sample CC-GW-4 had elevated iron (978 ppb), mangan (189 ppb), and zinc (464 ppb). Groundwater sample CC-GW-5 had elevated manganese (25 ppb) and vanadium (4B ppb). Groundwater sample CC-GW-7 had elevated aluminum (411 ppb), iron (1,290 ppb), manganese (111 ppb), vanadium (5.5B ppb), and zinc (107 ppb). Groundwater sample CC-GW-8 had elevated aluminum (2,500 ppb), beryllium (14.6 ppb), cadmium (50.6 ppb), cobalt (39.2B ppb), copper (139 ppb), iron (4,490 ppb), lead (180 ppb), manganese (1,540 ppb), nickel (28.9B ppb), thallium (6B ppb), vanadium (8.1B ppb), and zinc (7,040 ppb).

Four analytes exceeded the MCLs in two samples. Groundwater sample CC-GW-8, the Hayst Creek Mine adit discharge, exceeded the MCLs for beryllium, cadmium, and thallium and the action level for lead. Groundwater sample CC-GW-1, the upgradient spring sample, exceeded the action level for lead (19.5 ppb).

2.3 SOIL SAMPLES

Eleven composite, surficial (surface to six inches) soil samples were collected during this site inspection: one background soil and ten waste rock samples. Sample CC-SS-1 was collected upgradient of the upstream surface water sample, representing background conditions. Sampl CC-SS-2 and 3 were collected at the IXL-Eureka Mine Site. Samples CC-SS-4 and 12 were collected from the Ontario/Cornucopia Mine Site. Samples CC-SS-6 and 7 were collected at the Benton (Big Snowy) Mine Site. Sample CC-SS-8 was collected at the Haystack Mine Site. Sample CC-SS-9 was collected from an unnamed mine on Haystack Creek. Samples CC-SS- and 11 were collected from the Black Diamond Jay Mine Site.

Soil sample total metals sampling results are presented in Table 13. Elevated levels of total metals and background concentrations for those metals are presented on Figure 18.

Eighteen analytes were elevated at least three times background concentrations or above the detection limit, if background was not detected in the waste rock. The IXL-Eureka Mine Site (CC-SS-2 and 3) had elevated levels of antimony (35.6 ppm), arsenic (46.6 to 104 ppm), beryllium (0.26B to 1.2 ppm), chromium (2.2 to 7.7B ppm), copper (89.5N* ppm), iron (19,000* to 167,000* ppm), lead (2,380* to 5,270* ppm), mercury (0.78B to 0.83 ppm), silver (37.6 to 51 ppm), and zinc (1,120 to 1,360 ppm). The Ontario/Cornucopia Mine Site (CC-SS-4 and 12) had elevated levels of aluminum (6,100 ppm), arsenic (94.1 to 183 ppm), beryllium (0.23B to 0.83B ppm), cadmium (18.1* ppm), chromium (1.3B to 49.4 ppm), cobalt (15.8 ppm), iron (16,200* to 50,800* ppm), lead (177* to 4,340* ppm), manganese (1,050 ppm), mercury (3.4 ppm), nickel (48.5 ppm), silver (9.3 to 295 ppm), thallium (1.0B to 11.9 ppm), vanadium (37.5 ppm), and zinc (472 to 3,940 ppm).

The Benton (Big Snowy) Mine Site (CC-SS-6 and 7) had elevated levels of aluminum (4,660 ppm), antimony (18.1 to 62.9 ppm), arsenic (112 to 280 ppm), beryllium (0.36B to 0.64B ppm), chromium (11 to 14.6 ppm), cobalt (2.7B to 4.5B ppm), copper (181N* to 308N* ppm), iron (42,400* to 48,500* ppm), lead (1,180* to 5,020* ppm), mercury (0.49 ppm to 2.8 ppm), nickel (3.6B to 5B ppm), silver (36.9 to 125 ppm), vanadium (12.8 to 13.2 ppm), and zinc (472 ppm). The Black Diamond Jay Mine Site (CC-SS-10 and 11) had elevated levels of aluminum (14,100 ppm), antimony (10.7B to 16.5 ppm), arsenic (156 to 178 ppm), barium (213 ppm), beryllium (0.19B to 0.76B ppm), cadmium (28.9* ppm), chromium (17 to 191 ppm), cobalt (15.6 ppm), copper (172N* ppm), iron (61,200* to 93,900* ppm), lead (4,050* to 14,100* ppm), mercury (0.28 to 0.3 ppm), nickel (69.1 ppm), silver (18.7 to 41 ppm), vanadium (59.5 ppm), and zinc (1,780 to 7,480 ppm).

The Haystack Creek Mine Site (CC-SS-8) had elevated levels of aluminum (12,000 ppm), antimony (16.8 ppm), arsenic (24.9 ppm), barium (473 ppm), beryllium (0.94B ppm), chromium (9.5 ppm), cobalt (9.5B ppm), copper (304N* ppm), iron (63,500* ppm), lead (454* ppm), mercury (0.77 ppm), nickel (7.3B ppm), vanadium (83.3 ppm), and zinc (1,080 ppm). The unnamed mine on Haystack Creek (CC-SS-9) had elevated levels of antimony (82.1 ppm), arsenic (155 ppm), beryllium (0.3B ppm), cadmium (40.5* ppm), cobalt (3.3B ppm), copper (201N* ppm), iron (20,300* ppm), lead (2,330 ppm), mercury (0.4 ppm), silver (84.9 ppm), and zinc (7,690 ppm).

3.0 PRELIMINARY RISK ASSESSMENT

A risk assessment uses measured data to identify whether a particular chemical compound is linked to a health effect; the compound is then related to population exposure. The preliminary risk assessment for the Carpenter and Snow Creek Mining Complex Site only identifies whether a compound is linked to a health effect; population exposure is not considered.

3.1 CONTAMINANTS OF CONCERN

Table 14 summarizes the potential health effects associated with the contaminants at the sourc and the pathway contaminants that are elevated, attributable to the source, and not considered l contaminants at the site. Source contaminants of concern include the following: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc. The surface water pathway includes the following contaminants of concern: arsenic, barium, cadmium, copper, iron, lead. manganese, nickel, silver, thallium, and zinc. The groundwater pathway includes the followin contaminants of concern: aluminum, beryllium, cadmium, cobalt, copper, iron, lead, mangane nickel, thallium, vanadium, and zinc.

Information pertaining to health effects was gathered from toxicological texts including the Rapid Guide to Hazardous Chemicals in the Workplace (Sax, 1994), the Merck Index (Merck, 1983), the Pocket Guide to Chemical Hazards (NIOSH, 1985), and Threshold Limit Values for Chemical Substances and Physical Agents (ACGIH, 1995). Table 14 also lists the background concentration found at the site for the compound. The background concentration is presented comparison can be made with the compound identified at the site. At some sites, background concentrations are significant and should be taken into account.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

4.1.1 Source Characterization

The source samples were collected from the Haystack Creek drainage (Haystack Creek Mine S and the unnamed mine site) or the Snow Creek drainage (IXL-Eureka, Ontario/Cornucopia, Benton, Black Diamond Jay Mine Sites). Each site had at least eight (up to 16) elevated metal including: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc. Each site (except the Benton Big Snowy) was in or immediately adjacent to surface water.

4.1.2 Surface Water Pathway

The Carpenter Creek surface water and sediment samples (CC-SW/SD-1, 2, 4, and 5) had elevated levels of arsenic (sediment only), barium (sediment only), cadmium, copper, lead, manganese, nickel (sediment only), silver (sediment only), and zinc. All elevated analytes we attributable to the waste rock sources. The impact of Snow Creek on Carpenter Creek was evaluated by comparing sample CC-SW/SD-2, Carpenter Creek prior to the confluence with Snow Creek, to CC-SW/SD-4, Carpenter Creek after the confluence with Snow Creek. The analytes elevated in surface water prior to Snow Creek were the same (except for the addition iron) in lesser concentrations than the analytes elevated after Snow Creek. The analytes eleva in sediment prior to Snow Creek were the same (except for the addition nickel) in lesser concentrations (manganese and zinc were very slightly higher) than the analytes elevated after Snow Creek. Based on the above data, the elevated metals levels in Carpenter Creek appear to be caused by mine sites on Carpenter Creek rather than on Snow Creek. Snow Creek appears (generally) to dilute elevated metals in Carpenter Creek. However, certain precipitation events could likely cause Snow Creek to be a contributor to Carpenter Creek metals levels.

The Belt Creek surface water and sediment samples (CC-SW/SD-6, 7, and 8) had elevated levels of arsenic (sediment only), lead (surface water only), manganese (sediment only), and vanadium. All elevated analytes were attributable to the waste rock sources. The influence of Carpenter Creek on Belt Creek was evaluated by comparing elevated metals detected downstream in Belt Creek (CC-SW-7 and 8) to elevated metals detected in Carpenter Creek (CC-SW-1, 2, 4, and 5). Lead and vanadium are the only analytes elevated in downstream Belt Creek surface water. Lead was not detected upstream in Belt Creek. Vanadium is not elevated in any Carpenter Creek surface water sampling location or upstream in Belt Creek surface water. Based on the above data, Carpenter Creek appears to be the source of lead to Belt Creek; hence, Carpenter Creek is negatively affecting Belt Creek. The vanadium in Belt Creek cannot be explained through the surface water pathway, although, vanadium is elevated in source samples and the groundwater pathway.

Carpenter Creek surface water is being impacted by metals levels as evidenced by the exceedances of the freshwater AWQC for cadmium, copper, lead, and zinc. However, there is no fishery data available for Carpenter Creek at this time. Wetlands located on Carpenter Creek are being impacted as evidenced by elevated metals in surface water in wetlands locations. Belt Creek surface water has elevated metals levels. And, while there is a fishery on Belt Creek, the metals levels do not exceed freshwater AWQC.

4.1.3 Groundwater Pathway

The domestic well (CC-GW-2) had elevated levels of copper (the field duplicate groundwater sample was significantly outside of the control limit), iron, manganese, and vanadium. All elevated analytes were attributable to the waste rock sources. There were no MCLs exceeded.

The adit discharges (CC-GW-4, 5, 7, and 8) had elevated levels of aluminum, beryllium, cadmium, cobalt, copper, iron, lead, manganese, nickel, thallium, vanadium, and zinc. All elevated analytes were attributable to waste rock sources. The MCLs for beryllium, cadmium, and thallium were exceeded and the action level for lead.

The upgradient groundwater sample (CC-GW-1), a spring in Neihart, exceeded the action level for lead.

4.1.4 Soil Exposure Pathway

There was surficial soil contamination documented at the sources. However, there was no population within 0.25 mile of the site.

4.2 RECOMMENDATIONS

The mines and mills in the Carpenter and Snow Creek Mining Complex Site have elevated lev of metals. These metals are affecting the drinking water and surface water pathways. The site should have a preliminary HRS scoring performed to determine eligibility for the NPL.

The analytical results of both groundwater drinking water samples (CC-GW-1 and 2) should be sent to the owners because analytes are elevated and lead exceeds the action level. If the site should progress through the Superfund process, prioritization for clean-up should be given to Carpenter Creek sites (Silver Dyke Complex and Carpenter Creek Tailings Site) because interpretation of analytical data shows the Snow Creek sites to have a lesser impact to Carpent Creek when compared to the Carpenter Creek sites.

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APPENDIX A

CERCLA ELIGIBILITY QUESTIONNAIRE

CERCLA ELIGIBILITY QUESTIONNAIRE

Site Name: Carpenter and Snow Creek Mining Complex Site

City: Neihart State: Montana

EPA ID Number: MTD0001096353

I. CERCLA ELIGIBILITY

	YES	NO
Did the facility cease operations prior to November 19, 1980?	X	

If the answer is YES, STOP, facility if probably a CERCLA site.

II. RCRA ELIGIBILITY

	YES	NO
Did the facility file a RCRA Part A application?	___	___
If YES:		
1. Does the facility currently have interim status?	___	___
2. Did the facility withdraw its Part A application?	___	___
3. Is the facility a known or possible protective filer?	___	___
4. Type of facility:		

Generator ___ Transporter ___ Recycler ___
TSD (Treatment/Storage/Disposal) ___

	YES	NO
Does the facility have a RCRA operating or post closure permit?	___	___
Is the facility a late (after (11/19/80) or non-filer that has been identified by the EPA or the State? (facility did not know it needed to file under RCRA).	___	___

If all answers to question in Part II are NO, STOP, the Facility is a CERCLA eligible site.

If answer to #2 or #3 is YES, STOP, the facility is a CERCLA eligible site.

If answer #2 and #3 are NO and any OTHER answer is YES, site is RCRA, continue to PART III.

III. RCRA SITES ELIGIBLE FOR NPL — YES NO

Has the facility owner filed for bankruptcy under federal or state laws? ___ ___

Has the facility lost RCRA authorization to operate or shown probably unwillingness to carry out corrective action? ___ ___

Is the facility a TSD that converted to a generator, transporter or recycler facility after November 19, 1980? ___ ___

IV. EXEMPTED SUBSTANCES

Does the release involve hazardous substances other than petroleum? ___ ___

The site may never reach the NPL. We need to be able to refer it to any other programs in E or state agencies which may have jurisdiction, and thus be able to effect a cleanup. Respons should summarize available information pertaining to the question.

1) Is there an owner or operator? Yes; numerous owners. Ownership is being researc by MDEQ

2) (NPDES-CWA) Is there a discharge water containing pollutants with surface water through a point source (pipe, ditch, channel, conduit, etc.)? YES

3) (Sec. 404-CWA) Have fill or dredged material been deposited in a wetland or on the banks of a stream? Is there evidence of heavy equipment operating in ponds, stream. wetlands? YES

4) (UIC-SDWA) Are fluids being disposed of to the subsurface through a well, cesspo septic system, pit, etc.? NO

5) (TSCA) It is suspected that there are PCB's on the site which came from a source wi greater than 50 ppm PCB's such as oil from electrical transformers or capacitors? _ Big Seven Mine Site

6) (FIFRA) Is there a suspected release of pesticides from a pesticide storage site? Are there pesticide containers on site? NO

7) (RCRA - Subtitle D) Is there an owner or operator who is obligated to manage solid waste storage or disposal units under State solid waste or groundwater protection regulations? NO

8) (UST) Is it suspected that there is a leaking underground storage tank containing a product which is a hazardous substance or petroleum? NO; above ground tanks at Big Seven Mine Site

APPENDIX B

LATITUDE AND LONGITUDE CALCULATION WORKSHEET

LATITUDE AND LONGITUDE CALCULATION WORKSHEET #2
LI USING ENGINEER'S SCALE (1/60)

SITE NAME: Carpenter and Snow Creek Mining Complex Site CERCLIS #:MTD0001096353
AKA SSID:
ADDRESS: NE 1/4, Section 20, T14N, R08E
CITY: Neihart STATE: Montana ZIP CODE: 59465
SITE REFERENCE POINT: Confluence of Snow and Carpenter Creeks
USGS QUAD MAP NAME: Neihart
TOWNSHIP: 14N RANGE: 8E
SCALE: 1:24,000 MAP DATE 1961 SECTION: 20
MAP DATUM: 1927 MERIDIAN: Montana
COORDINATES FROM LOWER RIGHT (SE) CORNER OF 7.5" MAP
(attach photocopy)
LONGITUDE: 110° 37' 30" LATITUDE: 46° 52' 30"

COORDINATES FROM LOWER RIGHT (SE) CORNER OF 2.5' GRID CELL:
LONGITUDE: 110° 42' 30" LATITUDE: 46° 57' 30"

CALCULATIONS: LATITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM LATITUDE GRID LINE TO SITE REF POINT: 36
B) MULTIPLY (A) BY 0.3304 TO CONVERT TO SECONDS:
A x 0.3304 = 11.89 "
C) EXPRESS IN MINUTES AND SECONDS (1' = 60"): ' 11.89
D) ADD TO STARTING LATITUDE: 46° 57' 30" + 11.89 =

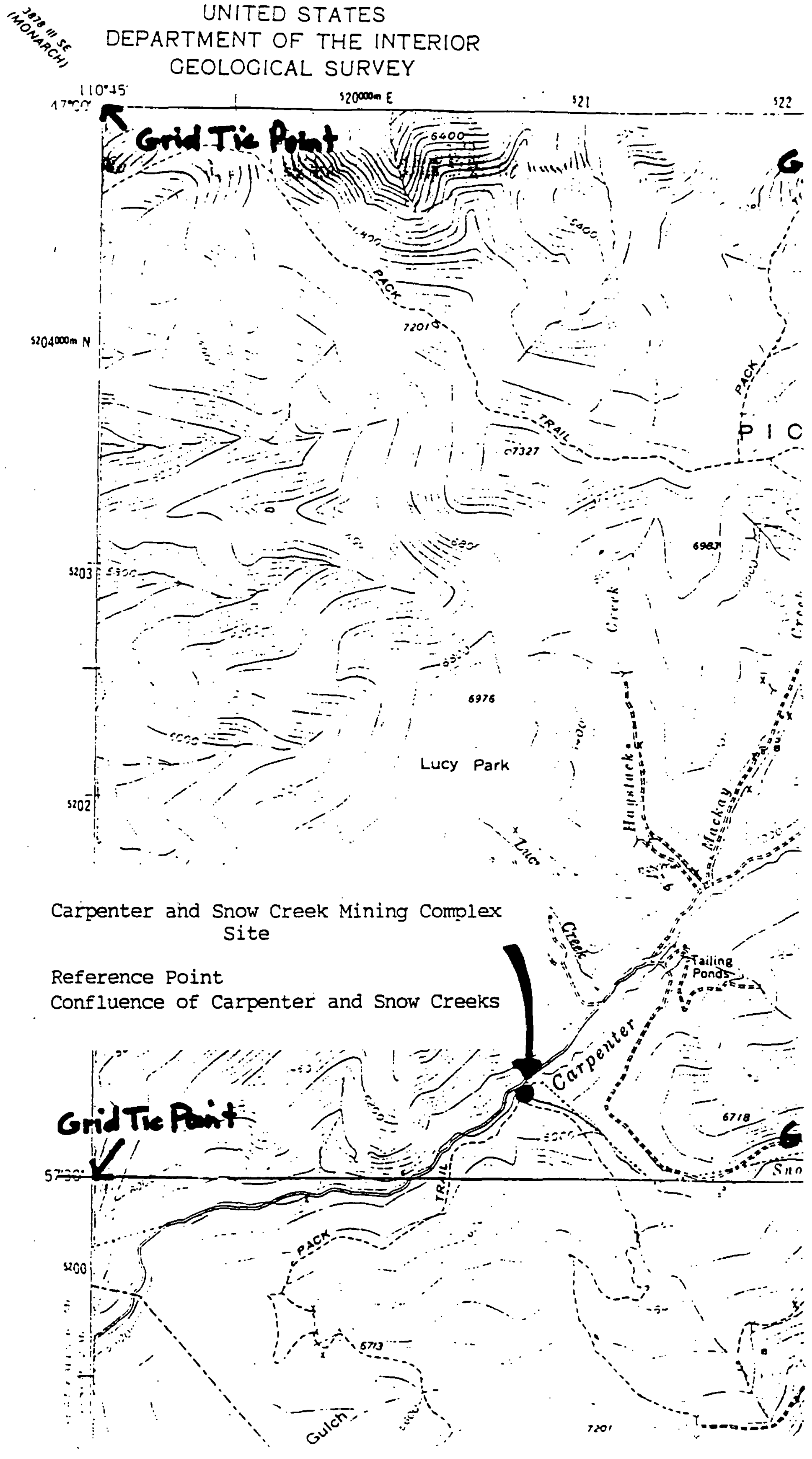
SITE LATITUDE: 46° 57' 41.89"

CALCULATIONS: LONGITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM L GRID LINE TO SITE REF POINT: 132
B) MULTIPLY (A) BY 0.4808 TO CONVERT TO SECONDS:
A x 0.4808 = 63.46"
C) EXPRESS IN MINUTES AND SECONDS (1' = 60"): 1' 3.46
D) ADD TO STARTING LONGITUDE: 110° 42' 30" + 1' 3.46 =

SITE LONGITUDE: 110° 43' 33.46"

INVESTIGATOR: Dave Clark DATE: 12-26-95


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
3878 III SE
(MONARCH)
110°45'
47°00'
520000m E
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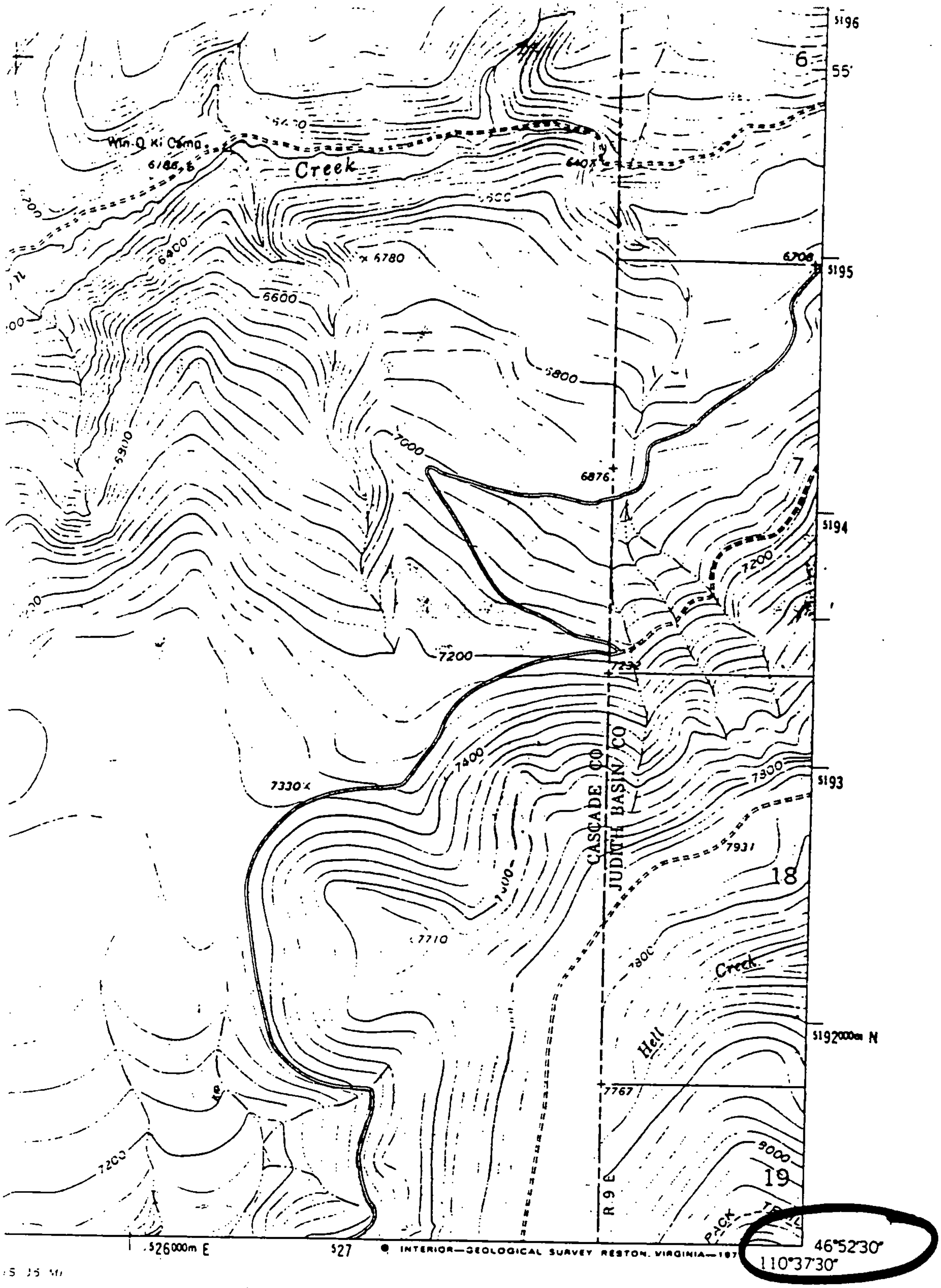
6400
PACK
7201
5204000m N
TRAIL
7327
PIC
6983
5203
Creek
6976
Lucy Park
Haystack
Mackay
5202
Carpenter and Snow Creek Mining Complex
Site
Reference Point
Confluence of Carpenter and Snow Creeks
Creek
Tailing
Ponds
Carpenter
6718
Grid Tie Point
57'30"
TRAIL
PACK
5200
6713
Gulch
7201



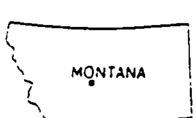
MILE

ROAD CLASSIFICATION

Medium-duty ———— Light-duty ————

Unimproved dirt - - - - - - -

U.S. Route



QUADRANGLE LOCATION

NEIHART, MONT.

N4652.5—W11037.5/7.5

1961

AMS 3877 I NW—SERIES V894

APPENDIX C

EPA REGION VIII PA WORKSHEET

Preparer's Name Meg Babits Location Neihart, Montana

Site Name Carpenter and Snow Creek Mining Complex Site Date 6-95

MAJOR CONSIDERATIONS

A) Does any qualitative or quantitative information exist that may indicate an observed release to air, ground water, soil or surface water? Yes

Describe: 1994 analytical data collected for the MDEQ/Abandoned Mine Reclamation Bureau by Pioneer Technical Services, Inc.

B) If the answer to #1 is yes, is there evidence of drinking water supply contamination or any other target contamination (i.e., food chain, recreation areas, or sensitive environments)?

Describe: Surface water and sediment had elevated levels of metals that were attributable to the sources.

C) Are there sensitive environments within a 4-mile radius or 15 downstream miles of the site? Yes If yes, describe if any of the following apply:

- Multiple sensitive environments? No
- Federally designated sensitive environment(s)? No
- Sensitive environment(s) downstream on a small or slow flowing surface water body? No

D) Is the site located in an area of karst terrain? No

Describe: __

E) Does the waste source lie fully or partially within a wellhead protection area as designated according to section 1428 of the Safe Drinking Water Act? No

F) Does any qualitative or quantitative information exist that people live or attend school on onsite contaminated property? No

Describe: __

SITE INFORMATION

1. Site Name: Carpenter and Snow Creek Mining Complex Site

Address: Carpenter Creek Road

City: Neihart County: Cascade State: MT Zip code: 59465

EPA ID: MTD0001096353

Latitude: 46° 57' 41.89" Longitude: 110° 43' 33.46"

2. Directions to site (from nearest public road): From Great Falls, Montana, travel south on Highway 89 toward Neihart. Approximately one mile north of Neihart, Carpenter Creek intersects Belt Creek. At this confluence, there is a gravel road (Forest Road 3323) which travels along Carpenter Creek to the northwest. This road accesses all mine sites on Carpenter Creek. The mine sites up Snow Creek are behind a locked gate.

3. Site ownership history (Use additional sheets, if necessary):

   A. Name of current owner: Numerous complicated private ownership of various private mining claims within the Lewis and Clark National Forest. The MDEQ/AMRB in Helena, Montana, would have the most correct ownership records.

      Address: __

      City: __ County: __ State: __ Zip code: __

      Dates: From __ To __ Phone: __

   B. Name of previous owner: __

      Address: __

      City: __ County: __ State: __ Zip code: __

      Dates: From __ To __ Phone: __

   Source of ownership data: __

4. Type of ownership (Check all that apply):

   X Private __ State __ Municipal __ Federal

   __ County __ Other (describe): __

5. Name of site operator: Again, numerous parties operated each mine site.

   Address: __

   City: __ County: __ State: __ Zip code: __

   Dates: From __ To __ Phone: __

BACKGROUND/OPERATING HISTORY

6. Describe operating history of site: Claims were located in the area as early as 1883 and mining began in the area as early as 1897. The major mining operations ended by 1950.

   Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

7. Describe site and nature of site operations (property size, manufacturing, waste disposal, storage, etc.): The site is private mining claims within the USDA Forest Service, Lewis and Clark National Forest. The area within the 5,000 acre drainage basin is steep and rugged. Operations included underground mining and milling facilities.

   Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

8. Describe any emergency or remedial actions that have occurred at the site: None

   Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

9. Are there records or knowledge of accidents or spills involving site wastes? No

   Describe: _

   Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

10. Discuss existing sampling data and briefly summarize data quality (e.g., sample objective, age/comparability, analytical methods, detections limits and QA/QC): The MDEQ/AMRB performed hazardous materials inventory investigations in 1994 at six mines within the site and in 1993 at eight mines within the site. Soil, waste, groundwater, surface water and sediment samples were collected. The data have sufficient QA/QC to make it similar to EPA CLP quality. A 1990 Environmental Assessment by MDEQ/AMRB and a sampling in 1973 by MDEQ/Water Quality Bureau produced limited data. These data have limited QA/QC and should only be used for screeening purposes.

    Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

WASTE CONTAINMENT/HAZARDOUS SUBSTANCE IDENTIFICATION

11. For each source at the site, summarize on Table 1 (page 12): 1) methods of hazardous substance disposal, storage or handling; 2) size/volume/area of all features/structures that might contain hazardous waste; 3) condition/integrity of each storage disposal feature or structure; and 4) types of hazardous substances handled.

12. Briefly explain how waste quantity was estimated (e.g., historical records or manifests, permit applications, air photo measurements, etc.): Waste quantity was estimated during the 1994 and 1993 MDEQ/AMRB-Pioneer hazardous material inventory investigation.

    Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

13. Describe any restrictions or barriers on accessibility to onsite waste materials: Six of the fourteen mine sites are on a road with a locked gate

    Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

GROUND WATER CHARACTERISTICS

14. Any positive or circumstantial evidence or a release to ground water? No

    Describe: __

    Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

15. On Table 2 (page), give names, descriptions, and characteristics of geologic/hydrogeologic units underlying the site.

16. Net precipitation: Unknown

SURFACE WATER CHARACTERISTICS

17. Are there surface water bodies within 2 miles of the site? Yes

    __ Ditches   __ Lakes   __ Pond

    X Creeks   __ Rivers   __ Other __

18. Discuss the probable surface runoff patterns from the site to surface waters: Most of the mine sites are adjacent to or in a creek or tributary.

19. Provide a simplified sketch of surface runoff and surface water flow system for 15 downstream miles (see item #36).

20. Any positive or circumstantial evidence of surface water contamination? Yes

    Describe: The 1994 and 1993 MDEQ/AMRB-Pioneer analytical data.

    Source of information: MDEQ/AMRB-Pioneer site investigation logsheets

21. Estimate the size of the upgradient drainage area from the site: 5,000 acres.

Source of information: USGS Topographic map

22. Determine the average annual stream flow of downstream surface waters.

Water body: Carpenter Creek Flow: 5-10 cfs

Water body: Snow Creek Flow: 1.5 cfs

Water body: Belt Creek Flow: 125 cfs

Source of information: Measured and USGS

23. Is the site or portions thereof located in surface water? Yes

24. Is the site located in a floodplain (indicate flood frequency)? Yes; some of the mine sites are located in the one-year floodplain of Carpenter or Snow Creeks.

25. Identify and locate (see item #36) any surface water recreation area within 15 downstream miles of the site: None

Source of information: MRIS database

26. Two year 24-hour rainfall: 2.2

TARGETS

27. Discuss ground water usage within four miles of the site: Some use of groundwater for domestic purposes.

Source of information: Montana Bureau of Mines and Geology

28. Summarize the population served by ground water on the table below:

Distance (miles)	Population
0 - 1/4	2.6 (Hawthorne)
1/4 - 1/2	2.6 (Mammen)
1/2 - 1	0
1 - 2	0

2 - 3	5.2
3 - 4	17

Source of information: Montana Bureau of Mines and Geology and Census Bureau Data

29. Identify and locate (see item #36) population served by surface water intakes within 15 downstream miles of the site: 2.6

30. Describe and locate fisheries within 15 downstream miles of the site (i.e., provide standing crop of production and acreage, etc.): Belt Creek.

    Source of information: MRIS and Montana Department of Fish, Wildlife and Parks

31. Determine the distance from the site to the nearest of each of the following land uses.

Description	Distance
Commercial/Industrial Institutional	1.5 miles
Single Family Residential	1,000 feet (Hawthorne)
Multi-Family Residential	Unknown
Park	Unknown
Agricultural	10 miles

Source of information: USGS Topographic map

32. Summarize the population within a four-mile radius of the site:

Distance (miles)	Population
0 - 1/4	2.6 (Hawthorne)
1/4 - 1/2	2.6 (Mammen)
1/2 - 1	0
1 - 2	33.4
2 - 3	54

3 - 4 10.3

Source of information: Lewis and Clark National Forest Map and Census data

OTHER REGULATORY INVOLVEMENT

33. Discuss any permits:

County: Unknown

State: Unknown

Federal: Unknown

Other: Unknown

Source of information: __

34. SKETCH OF SITE

Include all pertinent features, e.g., wells, storage areas, underground storage tanks, waste areas, buildings, access roads, areas of ponded water, etc. Attach additional sheets with sketches of enlarges areas, if necessary.

North (up)

See Figures in report

35. SURFACE WATER FEATURES

Provide a simplified sketch of surface runoff and surface water flow system for 15 downstream miles. Include all pertinent features, e.g., intakes, recreation areas, fisheries, gauging stations, etc.

See Figure in report	North (up)

TABLE 1

WASTE CONTAINMENT AND HAZARDOUS SUBSTANCE IDENTIFICATION[1]

SOURCE TYPE	SIZE (Volume/Area)	ESTIMATED WASTE QUANTITY	SPECIFIC COMPOUNDS	CONTAINMENT[2]	SOURCES OF INFORMATION
Pile (Hutchinson)	130 cubic yards	Unknown	Unknown	None	MDEQ/AMRB-Pioneer files
Pile (Snow Creek Mill)	183 cubic yards	Unknown	Sb, Cu, Pb, Hg, Ag, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Lexington No.4)	6,600 cubic yards	Unknown	Sb, As, Cd, Cu, Pb, Hg, Ag, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Ripple Mines)	6,100 cubic yards	Unknown	As, Ba, Cd, Cu, Pb, Hg, Ag, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Rebellion Mines)	64,920 cubic yards	Unknown	Sb, As, Ba, Cd, Cu, Pb, Mn, Hg, Ag, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Emma)	520 cubic yards	Unknown	Sb, As, Cd, Cu, Pb, Mn, Ag, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Big Seven Mine)	2,580 cubic yards	Unknown	Sb, As, Cd, Pb, Mn, Hg, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Baker)	420 cubic yards	Unknown	Sb, Ba, Cu, Hg	None	MDEQ/AMRB-Pioneer files

Pile (Vilipa)	5,700 cubic yards	Unknown	Cu, Hg	None	MDEQ/AMRB-Pioneer files
Pile (Carpenter Ck Tailings)	111,000 cubic yards	Unknown	Sb, As, Ba, Cd, Cu, Pb, Mn, Hg, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Silver Dyke Mill)	82,600 cubic yards	Unknown	As, Ba,Cd, Cu, Pb, Mn, Hg, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Silver Dyke Tailings)	56,350 cubic yards	Unknown	As, Ba,Cd,Cu, Pb,Mn,Hg	None	MDEQ/AMRB-Pioneer files
Pile (Silver Dyke Adit)	12,100 cubic yards	Unknown	Sb,As,Cd, Cu,Fe,Pb,Mn,Hg, Zn	None	MDEQ/AMRB-Pioneer files
Pile (Sherman No. 2)	200 cubic yards	Unknown	Unknown	None	MDEQ/AMRB-Pioneer files

[1] Use additional sheets in necessary.

[2] Evaluate containment of each source from the perspective of each migration pathway (e.g., groundwater pathway - non-existent, natural or synthetic liner, corroding underground storage tank; surface water - inadequate freeboard, corroding bulk tanks; air - unstabilized slag piles, leaking drums, etc.)

TABLE 2

HYDROGEOLOGIC INFORMATION[1]

STRATA NAME/DESCRIPTION	THICKNESS (FT.)	HYDRAULIC CONDUCTIVITY (cm/sec)	TYPE OF DISCONTINUITY[2]	SOURCE OF INFORMATION
Unknown				

[1] Use additional sheets in necessary.

[2] Identify the type of discontinuity within four-miles from the site (e.g., river, strata, "pinches out", etc.)

APPENDIX D

COPY OF FIELD LOGBOOK AND CHAIN OF CUSTODY FORMS

(18)

010

1730 Arrive GW-1
Buskirk Residence 236-5376
Spring coming out of PVC pipe

pH = 8.91
temp = 9.0
SC = 19

flow ≈ 20 gpm

photo 30 GW-1

GW-1
MHDR 20

(16)

① 10 x 55' x 25' high
dump is in creek
collapsed adit

② 15' x 130' x 3' high
dump that was sampled
dump in creek
photo 26 looking at dump that
was sampled larger
dump in bkg.

Photo 28 GW-2

(17)

Spoke to Mayor "Buzz" Buskirk
O'Brian Ck city water
Only 2 houses (weekenders) on Wells
[illegible]
Monarch = McMillan ①
house [illegible] .8 Mc
right side [illegible]
[illegible]

[illegible] ②
Dr.
down street
go around [illegible]
2nd place on right
high (mid) on hill

(14)

1330 Arrive IXL-Eureka

① Adit discharge flows into drainage
≈ 6gpm ; 5'x4' x ? back open
orange staining on rocks
temp 6.8
pH = 7.29 photo 25 discharge
sc = 207

GW-4
8-137507
M11DA16

② dump at adit duplicate for spike
has dry area that once ran & is stained red
30' x 25' x 20' high Chunks 80 yd³
SS-2 dup
MHDA14
8-137508 8-137510 open adit below this too dump ≈ 150 yds

③ dump at ~~shaft~~ nes collapsed adit
SS-3 25' x 30' x 95' long ~~high~~ x 3' deep
8-137509
MHDA165 photo 24 looking at side of dump north.

(15)

1600 Arrive Haystack Site

25 yd³ dump in creek
SS-8
MHDA17
8-137511
Creek flows app. 25 30gpm at toe of dump
Adit on site is collapsed, some water ponded outside of it, but no flow
No veg on dump

1630 Arrive at a site downstream on Haystack Cr
2 dumps + 1 discharging adit
SS-9 MHDA18 both collapsed
8-137512
GW-8 Adit discharge = 5gpm red staining
temp 8.8 MHDA19
pH = 3.8 8-137513
sc = 610

1115 Arrive Ontario
Adit discharge | CC-GW 5 (1130)
Flow ≐ 8gpm | 8-137504
temp = 3.9 | MHDA11
pH = 7.66
sc = 52
flow runs immediately adjacent to dump
adit is collapsed

Dump CC-SS-4
30' x 36' x 30' high Chen est. is 250yd³
lots of erosion gullies
tracks highwall = 30'
SS-4
MHDA10
8-137503

photo 22 looking at discharge flowing around dump

1200 Arrive Benton
collapsed adit w/ standing water

CC SS-6 upper dump
photo 21 looking up at upper dump
Chen est. 250yd³

SS-6
MHDA12
8-137505

1230
CC-SS-7 lower dump
has collapsed adit has water but not really flowing
<1gpm 25' highwall above adit
SS-7
MHDA13
8-137506

100' x 60' x 50' high Chen est 6500yd³
lots of erosion gullies
0% veg
photo 23 lower dump looking downgradient
Ripple in bkg.

(10)

1015 Arrive Cornucopia
1 collapsed shaft w/ lots of timbers
40x40' + 60' deep

1 dump 100' x 45' x 25' high
Chin estimates 1600 yd³
90' from toe to unnamed trib
lots of erosion but only goes 80'
before stopping (doesnt reach stream)

no sample collected at upper Cornucopia

(11)

CC-SS-12

1030 found a discharging adit and dump below Cornucopia directly in unnamed trib. [illegible] of Cornucopia

Dump has adit discharge flowing over it and trib flowing thru it
75' x 75' x 35' high   sample collected after trib
Chin estimates 750 yd³
photo 20 looking upstream at dump w/ Nrich
photo 21 looking at collapsed adit w/ trib

SS-12
B-137501
MHDA08

trib flows at ≈ 20 gpm
discharge flows at = 10 gpm

1045 CC-GW-9
temp 7.0
SC = 158
pH = 7.99

GW-9
MHDA09
B-137502

1915 CC-SW-10
Bottle Blank

SW-10
8-126922
MHDA04

1830 CC-SW-9
Rinsate

SW-9
8-126923
MHDA05

8/1/95

0900 Arrive at the Black Diamond Jay

CC-SS-10 and 11

0900
SS-10
upstream dump
8-126925
MHDA06

0915
SS-11
downstream dump
8-126924
MHDA07

40' from end of dump to sample
usm. seep at the base of the dump

visible sulfide minerals,
pyrite & quartz

Temp = 6.1° C
pH = 8.01 S.U.
SC = 207 umho/cm

adit discharge
~~seep~~ = 1-2 gpm
no sample collected

photo 18 looking east at dumps
sample SS-10 on right, left is SS-11
photo 19 looking east at collapsed bldg.

15' between bottom of dump & channel of the
unnamed trib at snow cr. Trib channel
is ≈ 10 gpm main trib is 50-60 gpm

(6)

One small dump on west side of creek between here & the Silver Dyke tailings

Photo 17 - JR looking up gradient Carpenter Creek

SD-1 composite upstream from sample for 25' because of lack of stream sediments

temp 11.7 flow 575 gpm
Sc 64 us/cm
pH 8.84

SW-1
MHCZ99
8-118 734

SD-1
MHDA00
8-118742

1645
SS-1

MHDA01
8-126919

About 150' upgradient of SW-1/SD-1
Forest soil
No signs of mining
Heavily treed

(7)

1730 GW-2
= 43 TD

1745 GW 6
4gpm approx according to owner
Jennings in Lewistown drilled well?
Took duplicate here duplicate

GW-2 1730
8-126920
MHDA02

GW 6 1745
8-126921
MHDA03

temp 8.7
Sc 219 us/cm
pH 8.10

in Mr. Nummy's well
pH was high thought it might come from a softener
had Pb done in ck .03mg/l
had As, Cd, Pb in well no detects

(4)

pH 8.53
sc 144.9
temp 16.7
water is clear, red staining on rocks

1530 CC-SW-3
CC-~~SW~~SD-3

Sample in Snow Crk 35' upgradient of conf. w/Carpenter Creek

Photo 14- looking upstream Snow Creek at conf. w/ Carpenter Creek

SW-3	SD-3
8-118736	8118744
MHCZ95	MHCZ96

pH 9.10
sc 135.6
temp 13.4

Water was clear

(5)

1540
CC-SW-2
CC-SD-2

Upstream of conf w/Snow Creek in Carpenter Creek

Photo 15- looking across Carpenter Crk (towards Snow Crk side) ~~at up~~ sample point in Carpenter Crk above Snow Creek

SW-2	SD-2
8-118735	8-118743
MHCZ97	MHCZ98

pH 8.64
temp 17.6
sc 149.3

Tailings in sediment - water is clear

1630
CC-SW-1
CC-~~SW~~SD-1

Upgradient Carpenter Crk where 1st road crosses creek

(2)

SW-7
8-118740
MHCZ87

SD-7
8-126917
MHCZ88
pH: 8.20
sc = 185.0
temp = 16.2 D

1415 SW-6
SD-6

Above Carpenter Ck confluence (100')
in Belt Ck
photo 11 looking upstream at sample
CC-SW/SD-6

SW-6
~~8-126916~~
8-118739
MHCZ89
sc = 158.3 pH = 8.59
temp = 14.6

SD-6
~~8-118734~~ 8-126916
MHCZ90

Belt Ck is clear a mid flow

(3)

1445 CC SW-5
CC SD-5
Carpenter Ck prior to confluence 100' upgradient above Belt Ck
with Belt Ck

Denise Arrives

pH 8.40
Temp 16.3
sc ~~15~~ 173.5

SD-5
8-126995
MHCZ92

SW-5
MHCZ91
8-118738

1515 CC-SW-4
CC-SD-~~4~~ 5

Carpenter Ck 25' just below conf.
w/snow Creek
photo #13 looking downstream
Carpenter Ck at sample pt

SW-~~4~~ 3
MHCZ93
8-118737

SD-~~4~~ 5
MHCZ94
8-118745

CONTENTS

PAGE NO.	REFERENCE	DATE

7/31/95

1215 Arrive Neihart
No Denise
Saw Liz
looked at wetlands from
Neihart to Monarch
Saw some

1245 CC-SW-8
CC SD-8
where Bridge crosses Belt Ck right
before Monarch.
Photo 9 looking at Belt Ck facing downstream
temp - 12.6
sc - 150.3
pH - 6.57

SW-8	SD-8
8-118741	8-126918
MHC285	MH9284

1345
In Belt Creek below conf. w/Carpenter Creek app 30'
CC-SW-7
CC-SD-7
Photo 10 looking downstream at Belt Creek - sample site in foreground

EPA United States Environmental Protection Agency
Contract Laboratory Program

Inorganic Traffic Report & Chain of Custody Record
(For Inorganic CLP Analysis)

SAS No. (if applicable) —

Case No. DCN 95-115
RAS# 23851

1. Project Code: 3318
Account Code:
2. Region No.: 8
Sampling Co.: Pioneer
4. Date Shipped: 8-3-95
Carrier: Fed Ex
Regional Information:
Sampler (Name): Meg Babits
Airbill Number: 5306432810
Non-Superfund Program:
Sampler Signature: Meg Babits
5. Ship To: Quanterra Environmental Svs.
St Louis Lab
13715 Rider Trail N.
Earth City, MO 63045
ATTN: Wade Price
Site Name: Carpenter + Snow Ck.
3. Purpose*
Lead: [ ] SF [ ] PRP [X] ST [ ] FED
Early Action: [ ] CLEM [ ] PA [ ] REM [ ] RI [X] SI [ ] ESI
Long-Term Action: [ ] FS [ ] RD [ ] RA [ ] O&M [ ] NPLD
City, State: Neihart, MT
Site Spill ID: —

6. Matrix (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (specify in Column A)

7. Preservative (Enter in Column D)
1. HCl
2. HNO3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other (specify in Column D)
N. Not preserved

CLP Sample Numbers (from labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type: Comp./Grab	D Preservative (from Box 7) Other:	E – RAS Analysis: Diss. Metals	Total Metals	Cyanide	Low only: NO_2/NO_3	Fluoride	High only: pH	Conduct.	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Corresponding CLP Organic Sample No.	J Sampler Initials	K Field QC Qualifier (B = Blank, S = Spike, D = Duplicate, R = Rinsate, PE = Perform. Eval, — = Not a QC Sample)
MHDA20	2	L	G	2		X						8-137514/137516/137515	CC-GW-1	8-1-95 1730	—	MB	S
MHDA02	2	L	G	2		X						8-126920	CC-GW-2	8/1/95 1730	—	MB	—
MHDA16	2	L	G	2		X						8-137507	CC-GW-4	8-1-95 1330	—	MB	—
MHDA11	2	L	G	2		X						8-137504	CC-GW-5	8/1/95 1130	—	MB	—
MHDA03	2	L	G	2		X						8-126921	CC-GW-6	8/1/95 1730	—	MB	—
MHDA09	2	L	G	2		X						8-137502	CC-GW-7	8/1/95 1045	—	MB	—
MHDA19	2	L	G	2		X						8-137513	CC-GW-8	8/1/95 1630	—	MB	—

Shipment for Case Complete? (Y/N): Y
Page 2 of 2
Sample(s) to be Used for Laboratory QC: MHDA20 Trip. Vol. for MS.
Additional Sampler Signatures: —
Chain of Custody Seal Number(s): —

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Meg Babits	8/3/95 1300				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none	

DISTRIBUTION: Green - Region Copy; White - Lab Copy for Return to Region; Pink - SMO Copy; Yellow - Lab Copy for Return to SMO

EPA Form 9110-1

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFINITIONS

A21-012-5 REV 3/93

362562

EPA United States Environmental Protection Agency
Contract Laboratory Program

Inorganic Traffic Report & Chain of Custody Record

(For Inorganic CLP Analysis)

SAS No. (if applicable): ——

Case No.: DCN 95-115 RASK 23851

1. Project Code	Account Code	2. Region No.	Sampling Co.	4. Date Shipped	Carrier
3318	——	8	Pioneer	8-3-95	Fed Ex

Regional Information:

Non-Superfund Program:

Sampler (Name): MEG BABITS

Sampler Signature: Meg Babits

Airbill Number: 5306432810

3. Purpose*

Lead: [ ] SF, [ ] PRP, [X] ST, [ ] FED

Early Action: [ ] CLEM, [ ] PA, [ ] REM, [ ] RI, [X] SI, [ ] ESI

Long-Term Action: [ ] FS, [ ] RD, [ ] RA, [ ] O&M, [ ] NPLD

Site Name: Carpenter + Snow Creek

City, State: Neihart MT

Site Spill ID: ——

5. Ship To: Quanterra Environmental Svcs.
St. Louis Lab
13715 Rider Trail N
Earth City, MO 63045
ATTN: Wade Price

6. Matrix (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (specify in Column A)

7. Preservative (Enter in Column D)
1. HCl
2. HNO_3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other (specify in Column D)
N. Not preserved

CLP Sample Numbers (from labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type: Comp./Grab	D Preservative (from Box 7) Other:	E – RAS Analysis: Diss. Metals	Total Metals	Cyanide	Low only: NO_2/NO_3	Low only: Fluoride	High only: pH	High only: Conduct.	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Corresponding CLP Organic Sample No.	J Sampler Initials	K Field QC Qualifier (B = Blank, S = Spike, D = Duplicate, R = Rinsate, PE = Perform. Eval, - = Not a QC Sample)
MHCZ99	1	L	G	2		X						8-118734	CC-SW-1	7/31/95 1630	—	MB	—
MHCZ97	1	L	G	2		X						8-118735	CC-SW-2	7/21/95 1540	—	MB	—
MHCZ95	1	L	G	2		X						8-118736	CC-SW-3	7/31/95 1530	—	MB	—
MHCZ93	1	L	G	2		X						8-118737	CC-SW-4	7/31/95 1515	—	MB	—
MHCZ91	1	L	G	2		X						8-118738	CC-SW-5	7/31/95 1445	—	MB	—
MHCZ89	1	L	G	2		X						8-~~[illegible]~~ MA 118739	CC-SW-6	7/31/95 1415	—	MB	—
MHCZ87	1	L	G	2		X						8-118740	CC-SW-7	7/31/95 1345	—	MB	—
MHCZ85	1	L	G	2		X						8-118741	CC-SW-8	7/31/95 1245	—	MB	—
MHDA05	1	L	G	2		X						8-126923	CC-SW-9	7/31/95 1830	—	MB	—
MHDA04	1	L	G	2		X						8-126922	CC-SW-10	7/31/95 1815	—	MB	—

Shipment for Case Complete? (Y/N)	Page	Sample(s) to be Used for Laboratory QC	Additional Sampler Signatures	Chain of Custody Seal Number(s)
Y	1 of 2	——	——	——

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Meg Babits	8-3-95 1300				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none

A21-012-5 REV. 3/93

DISTRIBUTION: Green - Region Copy; White - Lab Copy for Return to Region; Pink - SMO Copy; Yellow - Lab Copy for Return to SMO

EPA Form 9110-1

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFINITIONS

3F5761

EPA United States Environmental Protection Agency Contract Laboratory Program

Inorganic Traffic Report & Chain of Custody Record
(For Inorganic CLP Analysis)

SAS No. (if applicable): —

Case No.: 23851

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Account Code:
2. Region No.: 8
Sampling Co.: Pioneer
4. Date Shipped: 8-3-95
Carrier: Fed Ex
Regional Information:
Sampler (Name): Meg Babits
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ATTN: Wade Price

Site Name: Carpenter and Snow Creek
City, State: Neihart MT
Site Spill ID: —

3. Purpose*
Lead: SF, PRP, ST [X], FED
Early Action: CLEM, PA, REM, RI, SI [X], ESI
Long-Term Action: FS, RD, RA, O&M, NPLD

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1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (specify in Column A)

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2. HNO3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other (specify in Column D)
N. Not preserved

CLP Sample Numbers (from labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type: Comp./Grab	D Preservative (from Box 7) Other:	E – RAS Analysis: Diss. Metals	Total Metals	Cyanide	Low only: NO_2/NO_3	Fluoride	High only: pH	Conduct.	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Corresponding CLP Organic Sample No.	J Sampler Initials	K Field QC Qualifier B = Blank S = Spike D = Duplicate R = Rinsate PE = Perform Eval – = Not a QC Sample
MHDA15	5	L	C	6		X						8-137509	CC-SS-3	8/1/95 1330	—	MB	—
MHDA10	5	L	C	6		X						8-137503	CC-SS-4	8/1/95 1115	—	MB	—
MHDA12	5	L	C	6		X						8-137505	CC-SS-6	8/1/95 1200	—	MB	—
MHDA13	5	L	C	6		X						8-137506	CC-SS-7	8/1/95 1230	—	MB	—
MHDA17	5	L	C	6		X						8-137511	CC-SS-8	8/1/95 1600	—	MB	—
MHDA18	5	L	C	6		X						8-137512	CC-SS-9	8/1/95 1630	—	MB	—
MHDA06	5	L	C	6		X						8-126925	CC-SS-10	8/1/95 0900	—	MB	—
MHDA07	5	L	C	6		X						8-126924	CC-SS-11	8/1/95 0915	—	MB	—
MHDA08	5	L	C	6		X						8-137501	CC-SS-12	8/1/95 1030	—	MB	—

Shipment for Case Complete? (Y/N): N
Page 2 of 2
Sample(s) to be Used for Laboratory QC: —
Additional Sampler Signatures: —
Chain of Custody Seal Number(s): —

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Meg Babits	8/3/95 1300				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none	

DISTRIBUTION: Green - Region Copy; White - Lab Copy for Return to Region; Pink - SMO Copy; Yellow - Lab Copy for Return to SMO

EPA Form 9110-1

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFINITIONS

A21-012-5 REV. 3/93

362564

United States Environmental Protection Agency
Contract Laboratory Program

Inorganic Traffic Report & Chain of Custody Record
(For Inorganic CLP Analysis)

SAS No. (if applicable) ——

Case No. DCN 95-115
RAS# 23551

1. Project Code	Account Code	2. Region No.	Sampling Co.	4. Date Shipped	Carrier
3318		8	Pioneer	8-3-95	Fed Ex

Regional Information

Non-Superfund Program

Site Name: Carpenter Snow Ck

City, State: Neihart MT

Site Spill ID: ——

Sampler (Name): Meg Babits

Sampler Signature: Meg Babits

3. Purpose
- Lead: SF, PRP, [X] ST, FED
- Early Action: CLEM, PA, REM, RI, [X] SI, ESI
- Long-Term Action: FS, RD, RA, O&M, NPLD

Airbill Number: 5306432810

5. Ship To: Quanterra Environmental Svcs.
St Louis Lab
13715 Rider Trail N.
Earth City, MO 63045
ATTN: Wade Price

6. Matrix (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other (specify in Column A)

7. Preservative (Enter in Column D)
1. HCl
2. HNO3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other (specify in Column D)
N. Not preserved

CLP Sample Numbers (from labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type: Comp./Grab	D Preservative (from Box 7) Other:	E – RAS Analysis: Diss Metals	Total Metals	Cyanide	Low only: NO_2NO_3	Low only: Fluoride	High only: pH	High only: Conduct.	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Corresponding CLP Organic Sample No.	J Sampler Initials	K Field QC Qualifier (B = Blank, S = Spike, D = Duplicate, R = Rinsate, PE = Perform. Eval, — = Not a QC Sample)
MHDA00	5	L	G	6		X						8-118742	CC-SD-1	7/31/95 1630	—	MB	—
MHCZ98	5	L	G	6		X						8-118743	CC-SD-2	7/31/95 1540	—	MB	—
MHCZ96	5	L	G	6		X						8-118744	CC-SD-3	7/31/95 1530	—	MB	—
MHCZ94	5	L	G	6		X						8-118745	CC-SD-4	7/31/95 1515	—	MB	—
MHCZ92	5	L	G	6		X						8-126915 MB	CC-SD-5	7/31/95 1445	—	MB	—
MHCZ90	5	L	G	6		X						8-~~118739~~ MB 126916	CC-SD-6	7/31/95 1415	—	MB	—
MHCZ88	5	L	G	6		X						8-126917	CC-SD-7	7/31/95 1345	—	MB	—
MHCZ86	5	L	G	6		X						8-126918	CC-SD-8	7/31/95 1245	—	MB	—
MHDA01	5	L	MB ~~G~~ C	6		X						8-126919	CC-SS-1	7/31/95 1645	—	MB	—
MHDA14	5	L	MB ~~G~~ C	6		X						8-137508/8-137510	CC-SS-2	8/1/95 1330	—	MB	S

Shipment for Case Complete? (Y/N)	Page	Sample(s) to be Used for Laboratory QC	Additional Sampler Signatures	Chain of Custody Seal Number(s)
N	1 of 2	MHDA14 Dup. VOL for MS.	——	——

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Meg Babits	8/3/95 1300				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks Is custody seal intact? Y/N/none	

A21-0:2-5 REV 3/93

APPENDIX E

WETLANDS INVENTORY

Carpenter Creek Wetland Sites:

Site 1:
19 ac

Indicator Species:	Soil:
Poa glaucifolia	Typic Cryaquept
Carex rostrata	
Salix bebbiana	
Carex illota	
Geum macrophyllum	
Salix scouleriana	
Angelica arguata	
Senecio pseudaureus	
Equesetum arvense	
Juncus ensifolius	

Site 2:
0.8 ac

Indicator Species:	Soil:
Populus balsamifera	Aquic Cryofluvent
Smilacina stellata	
Alnus sinuata	
Equisetum hyemale	
Salix bebbiana	
Deschampsia caespitosa	

Site 3:
0.1 ac

Indicator Species	Soil:
Salix exigua	Aquic Cryofluvent
Alnus sinuata	
Equisetum fluvitale	
Cornus stolonifera	
Rubus ideaus	
Populus angustifolia	
Equisetum hyemale	
Salix bebbiana	
Salix scouleriana	
Calamagrostis canadensis	

Site 4:
0.1 ac

Indicator Species	Soil:
Alnus sinuata	Aquic Cryofluvent
Cornus stolonifera	
Salix bebbiana	
Bromus inermis	

Site 5:
15.3 ac

Indicator Species:	Soil:
Populus angustifolia	Aquic Cryofluvent
Salix pseudomonticola	
Alnus sinuata	
Salix scouleriana	
Deschampsia caespitosa	
Calamagrostis canadensis	
Carex rostrata	
Csrex illota	
Bromus inermis	
Geum macrophyllum	
Picea englemanii	

Site 6:
1.7 ac

Indicator Species	Soil:
Populus angustifolium	Aquic Cryofluvent
Alnus sinuata	
Salix scouleriana	
Pinus contorta	
Epilobium angustifolium	

Site 7:
0.24 ac

Indicator Species:	Soil:
Populus tremuloides	Aquic Cryofluvent
Pinus contorta	
Alnus sinuata	
Salix bebbiana	
Epilobium angustifolium	

Site 8:
0.24 ac

Indicator Species:	Soil:
Populus tremuloides	Aquic Cryofluvent
Alnus incana	
Salix bebbiana	
Equisetum fluvitale	

Site 9:
1.2 ac

Indicator Species:	Soil:
Cornus stolonifera	Aquic Cryofluvent
Bromus inermis	
Symphoricarpos albus	
Phleum pratense	
Pinus ponderosa	

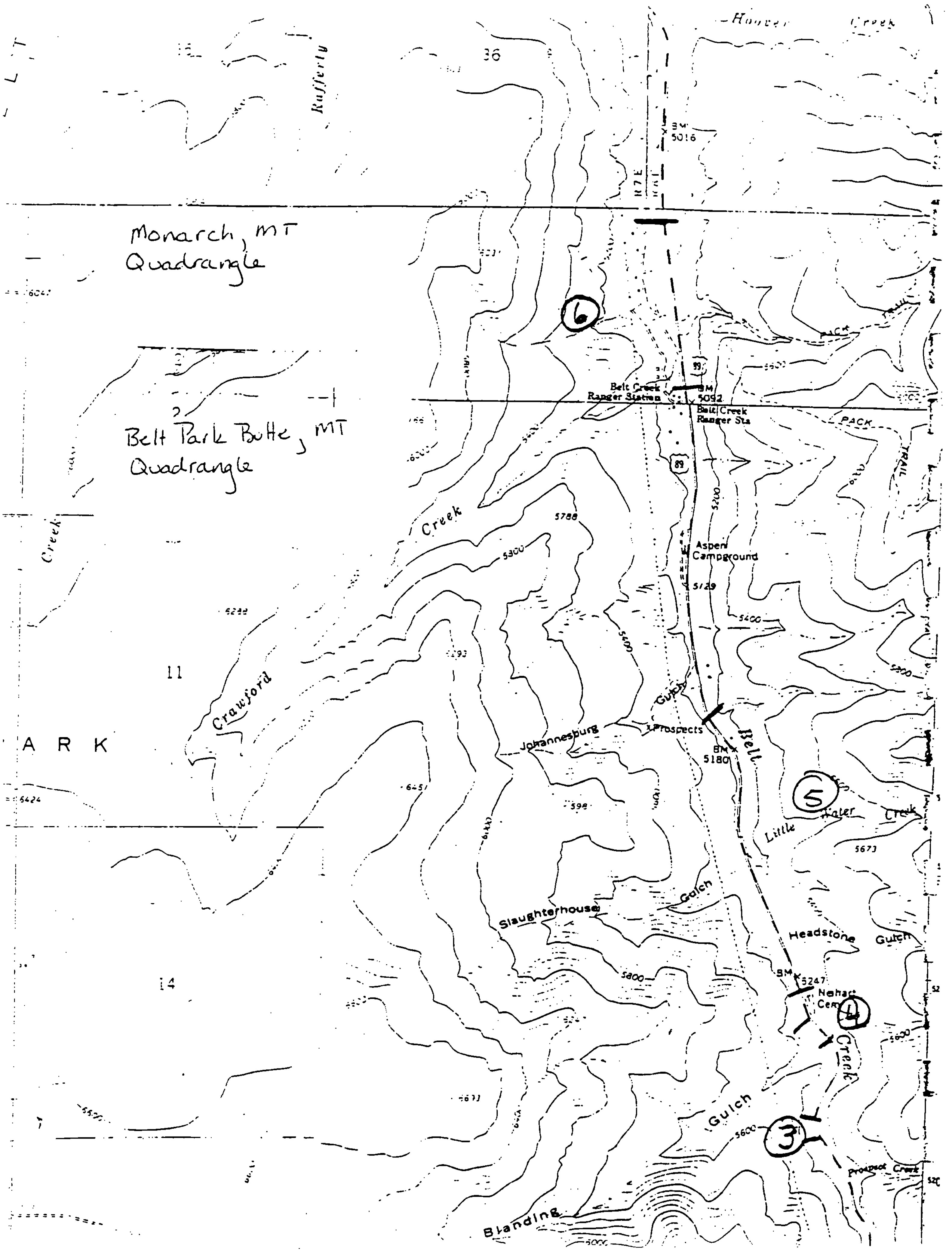
Site 10:
1 ac

Indicator Species:	Soil:
Salix scouleriana	Aquic Cryofluvent
Alnus sinuata	
Populus angustifolium	
Poa pratensis	
Deschampsia caespitosa	

Site 11:
1 ac

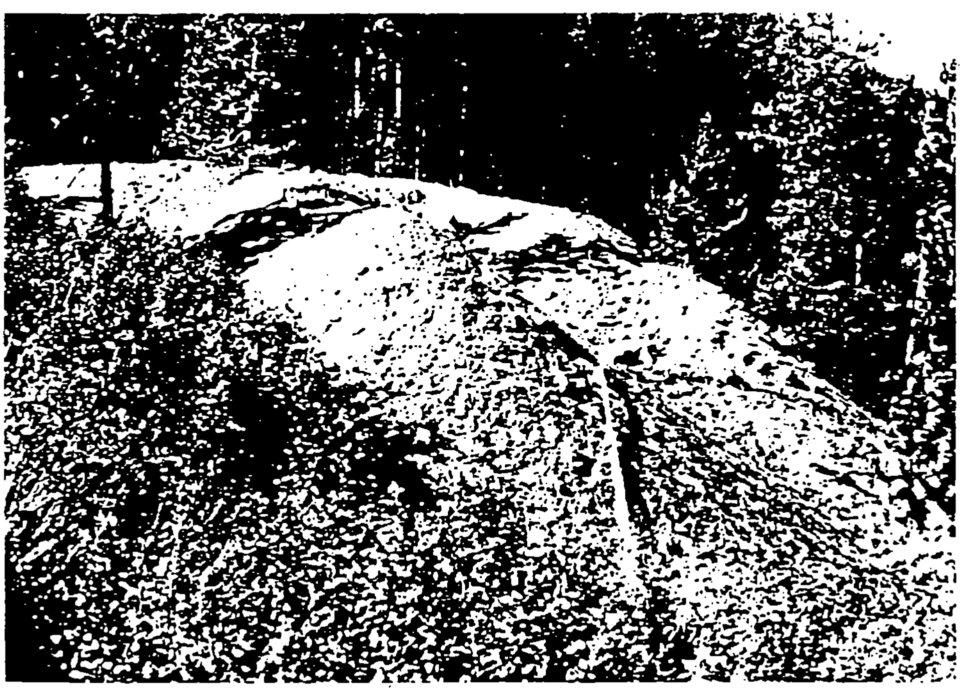
Indicator Species:	Soil:
Carex rostrata	Aquic Cryofluvent
Deschampsia caespitosa	
Salix scoulariana	
Alnus sinuata	
Populus angustifolia	

Neihart, MT
Quadrangle

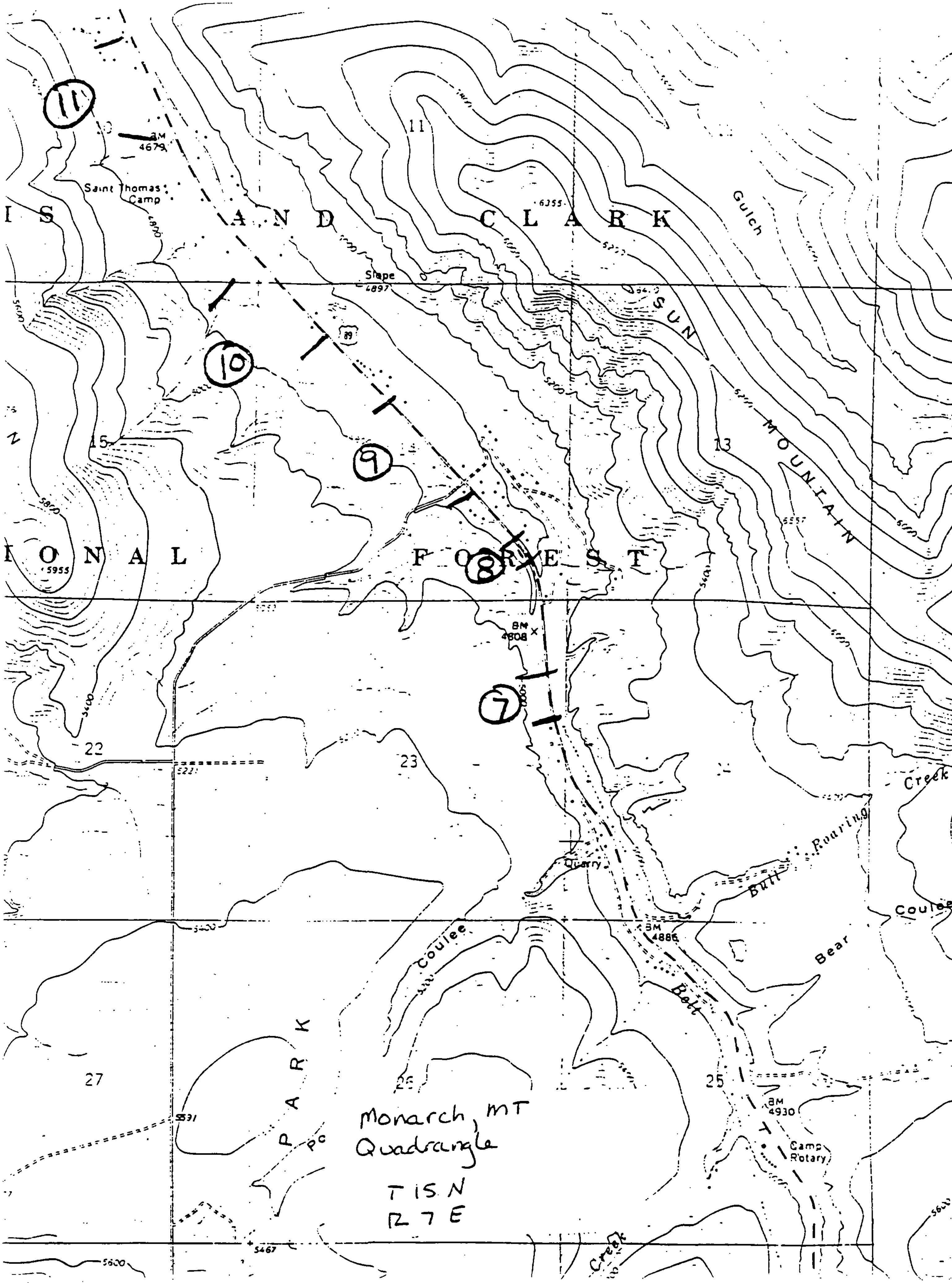


Hoover Creek
36
Rafferty
BM 5016
R7E
Monarch, MT Quadrangle
Belt Park Butte, MT Quadrangle
6
Belt Creek Ranger Station
BM 5092
Belt Creek Ranger Sta
89
PACK TRAIL
5600
Creek
5788
5300
5200
Aspen Campground
5129
5400
11
Crawford
Gulch
Prospects
Johannesburg
BM 5180
Bell
ARK
5
Little Water Creek
5673
6424
Slaughterhouse Gulch
Headstone Gulch
14
5800
BM 5247
Neihart Cem
4
Creek
Gulch
5600
3
Prospect Creek
Blanding

Adit discharge at Lucky Strike Mine Site.



Waste rock at Lucky Strike Mine Site.



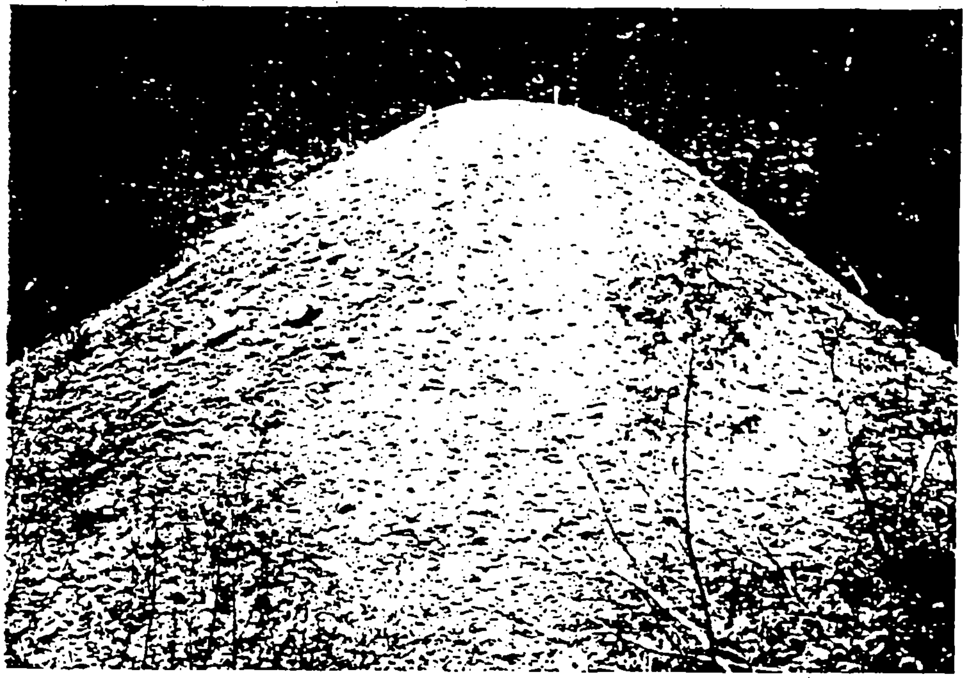
11
BM 4679
Saint Thomas Camp
I S A N D C L A R K
Gulch
6355
Slope 4897
S U N M O U N T A I N
89
10
15
9
13
5557
N O N A L F O R E S T
8
5955
BM 4808
7
22
23
Creek
Roaring
Quarry
Bull
Coulee
BM 4886
Coulee
Bear
Belt
P A R K
27
26
25
BM 4930
5591
Monarch, MT
Quadrangle
Camp Rotary
T 15 N
R 7 E
5467
5600
Creek

APPENDIX F

PHOTOGRAPHIC LOG

Waste rock at unnamed mine on Haystack Creek.

Adit discharge at unnamed mine on Haystack Creek.



Waste rock at unnamed mine on Haystack Creek.

Haystack Creek at the unnamed mine.

Waste rock at Haystack Creek Mine Site.

Waste rock at Lucky Strike Mine Site.

Open adit at Lucky Strike Mine Site.

Waste rock at Lucky Strike Mine Site.

Waste rock at IXL/Eureka Mine Site.

Waste rock at IXL/Eureka Mine Site.

Open shaft at IXL/Eureka Mine Site.

Open discharging adit at IXL/Eureka Mine Site.

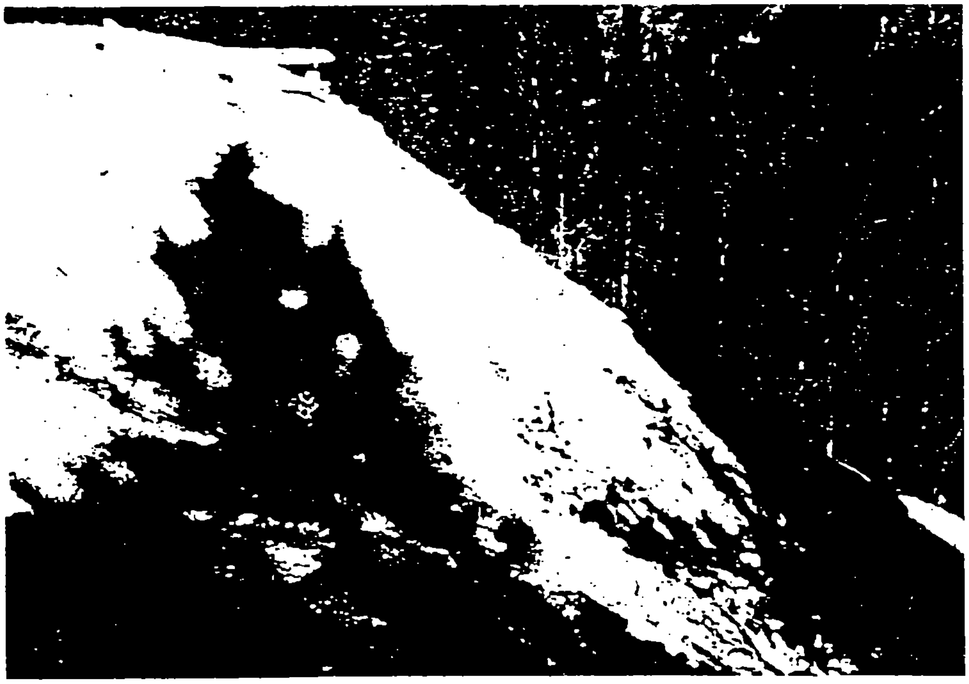
Waste rock at IXL/Eureka Mine Site.

Another open adit at IXL/Eureka Mine Site.

Waste rock at IXL/Eureka Mine Site.

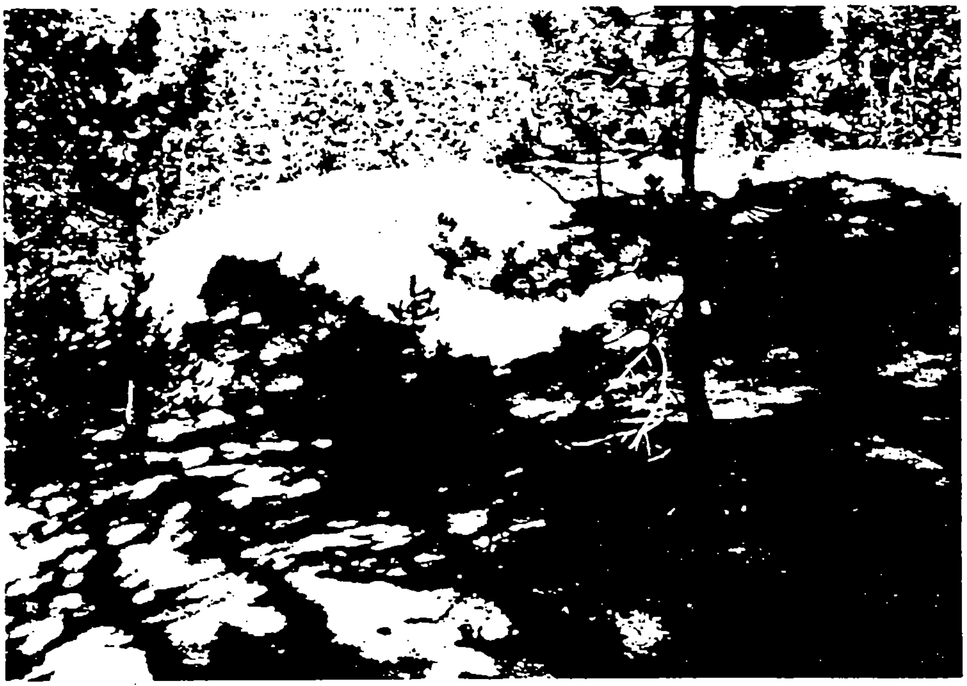
Waste rock at Benton (Big Snowy) Mine Site.

Waste rock at Benton (Big Snowy) Mine Site.



Waste rock at Benton (Big Snowy) Mine Site.

Waste rock at Ontario Mine Site.



Waste rock at Cornucopia Mine Site.

Erosion of waste rock towards drainage at Cornucopia Mine Site.

Collapsed shaft at Cornucopia Mine Site.

Waste rock at Cornucpia Mine Site.

Erosion of waste rock into drainage at Cornucopia Mine Site.

North end of dump at Black Diamond Jay Mine Site.

South end of dump at Black Diamond Jay Mine Site.

Adit with slight discharge at Black Diamond Jay Mine Site.

APPENDIX G

SITE INVESTIGATION DATA SUMMARY FORMS

SI Data Summary — Site Name Carpenter

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

Contractor Name or State Office and Address Pioneer Technical Services, Inc., P.O. Box 3445, Butte, MT 59702

GENERAL SITE INFORMATION

1. CERCLIS ID No. MTD0001096353
   Address N/A City Neihart
   County Cascade State MT Zip Code 59465 Congressional District 01

2. Owner name Numerous Owners Operator name ____
   Owner address ____ Operator address ____
   City ____ State ____ City ____ State ____

3. Type of ownership (check all that apply):
   X Private _ Federal/Agency ____ _ State _ County _ Municipal
   _ Other ____ Reference(s) Pioneer, 1995a

4. Approximate size of property: 5,000 (entire drainage basin) acres Reference(s) Pioneer, 1995a

5. Latitude 46 ° 57 ' 41.89 " Longitude 110 ° 43 ' 33.46 " Reference(s) Pioneer, 1995a

6. Site status: _ Active X Inactive _ Unknown Reference(s) Pioneer, 1995a

7. Years of operation: From: 1883 to: 1943 _ Unknown Reference(s) Pioneer, 1995a

8. Previous investigations:

Type	Agency/State/Contractor	Date	
Inv.	MDEQ/AMRB	6-7/94	Reference(s) Pioneer, 1995a
Inv.	MDEQ/AMRB	5-7/93	Reference(s) Pioneer, 1995a
EA	MDEQ/AMRB	1990	Reference(s) Pioneer, 1995a
Misc.	MDEQ/WQB	1973-1980	Reference(s) Pioneer, 1995a
			Reference(s)
			Reference(s)

Site Name_Carpenter and Snow Creek Mining Complex Site EPA Region_8_ Date_10/95

WASTE SOURCE INFORMATION

1. Waste source types (check all that apply)

_ Constituent
_ Wastestream (type)________
_ Landfill
_ Drums
_ Contaminated soil
_ Land treatment
_ Tanks or non-drum containers (type)_______
X Pile (type) Tailings and Waste Rock
_ Surface impoundment (buried)
_ Surface impoundment (backfilled)
_ Other_______

Reference(s) Pioneer, 1995a

2. Types of wastes (check all that apply)

_ Organic chemicals
_ Inorganic chemicals
_ Municipal wastes
_ Radionuclides
X Metals
_ Pesticides/Herbicides
_ Solvents
_ Other_______

Reference(s) Pioneer, 1995a

3. Summarize history of waste disposal operations:

Mining and milling began in the 1880's; produced overburden and tailings that were disposed to the ground surface with little or no containment in floodplain.

Reference(s) Pioneer, 1995a

SI Data Summary

Site Name Carpenter

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

4. Source characterization (Attach pages to show quantity and calculations.)

Source 1 name: Silver Dyke Tailings Site Source type Pile

Describe source: Uncontained tailings in unnamed tributary and Carpenter Creek
Ground water migration containment: No (10)
Surface water migration containment: No (10)
Air migration (gas and migration) containment: No (10)
Physical state of wastes: _ Liquid X Solid _ Sludge/Slurry _ Gas _ Unknown
Constituent quantity of hazardous substances: N/A (specify units)
Wastestream quantity containing hazardous substances: N/A (specify units)
Volume of source (yd^3): 56,350 Area of source (ft^2): 27,375

Hazardous substances associated with source 1:

As - 64.5 ppm	Cu - 5,510 ppm	Hg - 0.073 ppm
Ba - 1,040 ppm	Mn - 2,120 J ppm	
Cd - 8.1 JX ppm	Pb - 14,200 ppm	

Reference(s) Pioneer, 1995a

Source 2 name: Carpenter Creek Tailings Site Source type Pile

Describe source: Uncontained tailings in Carpenter Creek
Ground water migration containment: No (10)
Surface water migration containment: No (10)
Air migration (gas and migration) containment: No (10)
Physical state of wastes: _ Liquid X Solid _ Sludge/Slurry _ Gas _ Unknown
Constituent quantity of hazardous substances: N/A (specify units)
Wastestream quantity containing hazardous substances: N/A (specify units)
Volume of source (yd^3): 111,000 Area of source (ft^2): 76,500

Hazardous substances associated with source 2:

Sb - 5.24 ppm	Cd - 34.2 ppm	Mn - 6,870 ppm
As - 139 ppm	Cu - 3,450 ppm	Hg - 0.095 J ppm
Ba - 2,820 ppm	Pb - 7,870 ppm	Zn - 2,990 ppm

Reference(s) Pioneer, 1995a

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

CONTINUATION PAGE FOR SOURCE CHARACTERIZATION

Source #__ Name: N/A Source type________

Describe source: There are at least 19 other sources at this site. They are not included on these pages because Source #1 and #2 are by far the major (largest volume and highest concentration) sources at the site.
Ground water migration containment:________
Surface water migration containment:________
Air migration (gas and migration) containment:________
Physical state of wastes: __ Liquid __ Solid __ Sludge/Slurry __ Gas __ Unknown
Constituent quantity of hazardous substances:________ (specify units)
Wastestream quantity containing hazardous substances:________ (specify units)
Volume of source (yd³):________ Area of source (ft²):________

Hazardous substances associated with source #__:

________ ________ ________

________ ________ ________

________ ________ ________

Reference(s)________

Source #__ Name: N/A Source type________

Describe source:________
Ground water migration containment:________
Surface water migration containment:________
Air migration (gas and migration) containment:________
Physical state of wastes: __ Liquid __ Solid __ Sludge/Slurry __ Gas __ Unknown
Constituent quantity of hazardous substances:________ (specify units)
Wastestream quantity containing hazardous substances:________ (specify units)
Volume of source (yd³):________ Area of source (ft²):________

Hazardous substances associated with source #__:

________ ________ ________

________ ________ ________

Reference(s)________

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

5. Description of removal or remedial activities

If a removal has occurred, identify the removal authority and describe the activities. Specify the date(s) of the removal.

There has been no removal activity at the site.

Reference(s) Pioneer, 1995a

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

GROUND WATER INFORMATION

1. Ground water drinking water use within 4 miles of site sources:
   _ Municipal X Private _ Both _ No Drinking Water Use

   Reference(s) Pioneer, 1995

2. Is ground water contaminated:
   X Yes _ No _ Uncertain but likely _ Uncertain but not likely
   _ Additional sampling required
   Is analytical evidence available? X Yes _ No Reference(s) Pioneer, 1995b

3. Is ground water contamination attributable to the site?
   X Yes _ No _ Additional sampling required Reference(s) Pioneer, 1995b

4. Are drinking water wells contaminated?
   X Yes _ No _ Uncertain but likely _ Uncertain but not likely
   _ Additional sampling required
   Is any analytical evidence available? X Yes _ No Reference(s) Pioneer, 1995b

5. Net precipitation (HRS Section 3.1.2.2): Unknown inches Reference(s)

6. County average number of persons per residence: 2.6 Reference(s) Pioneer, 1995a

7. Discuss general stratigraphy underlying the site. Attach sketch of stratigraphic column.

   There is no information on underlying stratigraphy.

   Reference(s) Pioneer, 1995a

8. Using Table GW-1 (next page), summarize geology underlying the site (starting with formation #1 as closet to ground surface). Indicate if formation is interconnected with overlying formation.

Site Name_Carpenter and Snow Creek Mining Complex Site_ EPA Region_8_ Date_10/95_

TABLE GW-1: SITE GEOLOGY

NAME OF FORMATION	INTER-CONNECT? (yes/no)	TYPE OF MATERIAL	AVERAGE THICKNESS (FEET)	HYDRAULIC CONDUCTIVITY (CM/SEC)	USED FOR DRINKING WATER?
1. Unknown					
2.					
3.					
4.					
5.					
6.					

Reference(s)________________

9. Does a karst aquifer underlie any site source?
_ Yes X No Reference(s)____

10. Depth to top of aquifer: < 25 feet Elevation: Unknown Reference(s) Pioneer, 1995a

11. In the table below, enter the number of people obtaining drinking water from wells located within 4 miles of the site. For each aquifer, attach population calculation sheets. Key aquifer to formations listed in Table GW-1.

POPULATION SERVED BY WELLS WITHIN DISTANCE CATEGORIES BY AQUIFER

DISTANCE OF WELL(S) FROM SITE SOURCES	AQUIFER A: INCLUDES FORMATIONS___	AQUIFER B: INCLUDES FORMATIONS___	AQUIFER C: INCLUDES FORMATIONS___
1/4 mile or less	2.6		
>1/4 to 1/2 mile	2.6		
>1/2 to 1 mile	0		
>1 to 2 miles	0		
>2 to 3 miles	5.2		
>3 to 4 miles	17		

Reference(s) Pioneer, 1995a

Site Name_Carpenter and Snow Creek Mining Complex Site_ EPA Region_8_ Date_10/95__

12. Is ground water from multiple wells blended prior to distribution?
    _ Yes   X No   Reference(s)_Pioneer, 1995a

13. Is ground water blended with surface water?
    _ Yes   X No   Reference(s)_Pioneer, 1995a

14. Distance from any incompletely contained source available to ground water to nearest drinking water well (HRS Section 3.3.1): _1,000_ feet   Reference(s)_Pioneer, 1995c

Briefly describe:_There is a well located 1,000 feet from the Silver Dyke Adit Site.___

15. Briefly describe standby drinking water wells within 4 miles of sources at the site:

None___

Reference(s)_Pioneer, 1995a___

16. Using Table GW-2, summarize ground water analytical results for all sampling investigations. Include and identify background ground water sample results. (See Report)

17. Ground water resources with 4 miles of site sources (HRS Section 3.3.3):
    _ Irrigation (5-acre minimum) of commercial food or commercial forage crops
    _ Commercial livestock watering
    _ Ingredient in commercial food preparation
    _ Supply for commercial aquaculture
    _ Supply for major or designated water recreation area, excluding drinking water use
    _ Water usable for drinking water but no drinking water wells are within 4 miles
    X None of the above

Reference(s)_Pioneer, 1995a___

18. Wellhead protection area (WHPA) within 4 miles of site sources (HRS Section 3.3.4):
    _ Source with non-zero containment factor value lies within or above WHPA
    _ Observed ground water contamination attributable to site source(s) lies within WHPA
    _ WHPA lies within 4 miles of site sources
    X None

Reference(s)_Pioneer, 1995a___

Additional ground water pathway description:
None___

Reference(s)___

Site Name_Carpenter and Snow Creek Mining Complex Site EPA Region_8_ Date_10/95

SURFACE WATER INFORMATION

Complete this section of the data summary for each watershed if there are multiple watersheds. Photocopy this page if necessary.

1. Describe surface water migration path from site sources to at least 15 miles downstream. Attach a sketch of the surface water migration route.

Carpenter Creek is the primary drainage flowing northeast to the west and then southwest. It is approximately five miles from the headwaters of Carpenter Creek to the confluence with Belt Creek. Belt Creek flows into the Missouri River 70 miles downstream.

Reference(s)_Pioneer, 1995a

2. Is surface water contaminated?
X Yes _ No _ Uncertain but likely _ Uncertain but not likely
_ Additional sampling required
Is analytical evidence available? X Yes _ No Reference(s)_Pioneer, 1995b

3. Is surface water contamination attributable to the site?
X Yes _ No _ Additional sampling required Reference(s)_Pioneer, 1995b

4. Floodplain category in which site sources are located (check all that apply):
X 1-year _ 10-year _ 100-year _ 500-year _ None Reference(s)_Pioneer, 1995d

5. Describe flood containment for each source (HRS Section 4.1.2.1.2.2):

Source #1_Silver Dyke Tailings Flood containment: None
Source #2_Carpenter Creek Tailings Flood containment: None
Source #3_See #14 Flood containment_
Source #_ Flood containment_
Source #_ Flood containment_
Source #_ Flood containment_
Source #_ Flood containment_
Reference(s)_Pioneer, 1995a

6. Shortest overland distance to surface water from any source (HRS Section 4.1.2.1.2.1.3):
_0_ feet Reference(s)_Pioneer, 1995a

7. Size of drainage area (HRS Section 4.4.3):_5,000_ Acres Reference(s)_Pioneer, 1995a

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

8. Describe predominant soil group within the drainage area (HRS Section 4.1.2.1.2.1.2).

Floodplains - fluvents and borolls; hillsides - aquic cryoboralfs

Reference(s) Pioneer, 1995a

9. 2-year 24-hour rainfall (HRS Section 4.1.2.1.2.1.2):
2.2 inches Reference(s) Pioneer, 1995a

10. Elevation of the bottom of nearest surface water body:
Unknown feet above sea level Reference(s)

11. Elevation of top of uppermost aquifer:
Unknown feet above sea level Reference(s)

12. Predominant type of water body between probable point of entry to surface water and nearest drinking water intake: X River _ Lake Reference(s) Pioneer, 1995a

13. Identify all drinking water intakes, fisheries, and sensitive environments within 15 miles downstream.

TARGET NAME/TYPE	WATER BODY TYPE	DISTANCE FROM PPE	FLOW (CFS)	TARGET CHARACTERISTICS	TARGET SAMPLED?
Belt Creek/ Drinking Water	River	10	125	2.6	No
Belt Creek	River	5	125	Fishery (43 lbs./year)	Yes
Carpenter Creek	River	0	7.5	Wetland (0.5 mile)	Yes

If target is a drinking water intake, provide number of people served by intake.
If target is a fishery, provide species and annual production of human food chain organisms (pounds per year).
If target is a wetland, specify wetland frontage (in miles). Attach calculation pages.

Reference(s) Pioneer, 1995c

Site Name_Carpenter and Snow Creek Mining Complex Site_ EPA Region_8_ Date_10/95_

14. Is surface water drinking water blended prior to distribution?
_ Yes X No Reference(s)_Pioneer, 1995a

15. Describe any standby drinking water intakes within 15 miles downstream.

None

Reference(s)_Pioneer, 1995a

16. Surface water resources within 15 miles downstream (HRS Section 4.1.2.3.3):
- X Irrigation (5-acre minimum) of commercial food or commercial forage crops
- X Commercial livestock watering
- _ Ingredient in commercial food preparation
- X Major or designated water recreation area, excluding drinking water use
- _ Water designated by the state for drinking water use but is not currently used
- _ Water usable for drinking water but no drinking water intakes within 15 miles downstream
- _ None of the above

Reference(s)_Pioneer, 1995a

17. Using Table SW-1, summarize surface water analytical results for all sampling investigations. Include and identify background sample results. (See Report)

Site Name_Carpenter and Snow Creek Mining Complex Site EPA Region_8_ Date_10/95

SOIL INFORMATION

1. Is surficial or soil contamination present at the site?
   _X_ Yes _ No _ Uncertain but likely _ Uncertain but not likely
   _ Additional sampling required
   Is analytical evidence available? _X_ Yes _ No Reference(s)_Pioneer, 1995b

2. Is surficial or soil contamination attributable to the site?
   X (at sources) Yes _ No _ Additional sampling required Reference(s)_Pioneer, 1995b

3. Is surficial contamination on the property and within 200 feet of a residence, school, daycare center, or workplace?
   _ Yes _X_ No _ Uncertain but likely _ Uncertain but not likely
   _ Additional sampling required
   Is analytical evidence available? _ Yes _ No Reference(s)_____

4. Total area of surficial contamination (HRS Section 5.2.1.2):
   _103,875_ square feet Reference(s)_____

5. Attractiveness/accessibility of the areas of observed contamination (HRS Section 5.2.1.1). Check all that apply:
   _ Designated recreational area
   _ Used regularly, or accessible and unique recreational area
   _X_ Moderately accessible with some use
   _ Slightly accessible with some use
   _ Accessible with no use
   _ Inaccessible with some use
   _ Inaccessible with no use

   Reference(s)_Pioneer, 1993a

6. Using Table SE-1, summarize analytical results detecting surficial contamination within 200 feet of a residence, school, daycare center, or workplace. Include and identify background sample results. (See Report)

7. Using Table SE-2, summarize analytical results detecting surficial contamination within the boundary of a resource or a terrestrial sensitive environment. Include and identify background sample results if not listed in Table SE-1. (See Report)

8. Population within 1-mile travel distance from site. Do not include populations from Table SE-1.

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

DISTANCE FROM SITE SOURCES	POPULATION
1/4 mile or less	2.6
>1/4 to 1/2 mile	2.6
>1/2 to 1 mile	0

Reference(s) Pioneer, 1995a

Site Name_Carpenter and Snow Creek Mining Complex Site EPA Region_8_ Date_10/95

AIR INFORMATION

1. Is air contamination present at the site?
   _ Yes _ No _ Uncertain but likely X Uncertain but not likely
   _ Additional sampling required
   Is analytical evidence available? _ Yes X No Reference(s)_____

2. Is air contamination attributable to the site?
   _ Yes _ No _ Additional sampling required Reference(s)_____

3. Are populations, sensitive environments, or wetlands exposed to airborne hazardous substances released from the site?
   _ Yes _ No _ Uncertain but likely X Uncertain but not likely
   _ Additional sampling required
   Is analytical evidence available? _ Yes X No Reference(s)_____

4. Evidence of biogas release from any of the following source types at the site:
   _ Below-ground containers or tanks _ Landfill _ Buried surface impoundment
   Reference(s)_____

5. Particulate migration potential factor value:____ (HRS Figure 6-2)

6. Particulate mobility factor value:____ (HRS Figure 6-3)

7. Distance from any incompletely contained source to nearest residence or regularly occupied area:_0.3_ miles Reference(s)_Pioneer, 1995c

8. Population within 4 miles of site sources

DISTANCE FROM SITE SOURCES	POPULATION
0 (within site sources)	0
1/4 mile or less	2.6
>1/4 to 1/2 mile	2.6
>1/2 to 1 mile	0
>1 to 2 miles	33.4
>2 to 3 miles	54
>3 to 4 miles	10.3

Reference(s)_Pioneer, 1995a

Site Name_Carpenter and Snow Creek Mining Complex Site EPA Region_8_ Date_10/95

9. Resources within 1/2 mile of site sources (HRS Section 6.3.3):
   _ Commercial agriculture
   _ Commercial silviculture
   _ Major or designated recreation area
   X None of the above

   Reference(s)

10. Sensitive environments and wetlands within 4 miles of the site.

NAME/DESCRIPTION/LOCATION OF SENSITIVE ENVIRONMENT OR WETLAND	DISTANCE FROM SITE (MILES)	TYPE OF SENSITIVE ENVIRONMENT	WETLAND SIZE (ACRES)
Wetland	0	Wetland	19

Reference(s) Pioneer, 1995

11. Using Table Air-1, summarize air analytical results for all sampling investigations. Include and identify background sample results. (See Report)

Site Name Carpenter and Snow Creek Mining Complex Site EPA Region 8 Date 10/95

ADDITIONAL INFORMATION AND COMMENTS

The two sources listed appear to be significantly impacting the Carpenter Creek drainage. There are other mines in the Carpenter and Snow Creek Mining Complex that could create a more significant impact if, for example, a flood event occurred.

Pioneer, 1995a. Draft Site History Report for the Carpenter and Snow Creek Mining Complex Site, June 1995.
Pioneer, 1995b. Draft Analytical Results Report for the Carpenter and Snow Creek Mining Complex Site, August 1995.
Pioneer, 1995c. Draft Sampling Activities Report for the Carpenter and Snow Creek Mining Complex Site, August 1995.
Pioneer, 1995d. Draft Final Site Investigation Report for the Carpenter and Snow Creek Mining Complex Site.
Pioneer, 1993a. Hazardous Materials Inventory Site Investigation Log Sheet for the Carpenter Creek Tailings Site.
Pioneer, 1993b. Hazardous Materials Inventory Site Investigation Log Sheet for the Silver Dyke Tailings Site.

Reference(s)

APPENDIX H

LABORATORY ANALYTICAL DATA FORMS

LAB SAMPLE NUMBERS	SAMPLE NUMBER
MHCZ99	CC-SW-1
MHCZ97	CC-SW-2
MHCZ95	CC-SW-3
MHCZ93	CC-SW-4
MHCZ91	CC-SW-5
MHCZ89	CC-SW-6
MHCZ87	CC-SW-7
MHCZ85	CC-SW-8
MHDA05	CC-SW-9
MHDA04	CC-SW-10
MHDAOO	CC-SD-1
MHCZ98	CC-SD-2
MHCZ96	CC-SD-3
MHCZ94	CC-SD-4
MHCZ92	CC-SD-5
MHCZ90	CC-SD-6
MHCZ88	CC-SD-7
MHCZ86	CC-SD-8
MHDA20	CC-GW-1
MHDA02	CC-GW-2
MHDA16	CC-GW-4
MHDA11	CC-GW-5
MHDA03	CC-GW-6
MHDA09	CC-GW-7
MHDA19	CC-GW-8
MHDA01	CC-SS-1
MHDA14	CC-SS-2
MHDA15	CC-SS-3
MHDA10	CC-SS-4
MHDA12	CC-SS-6
MHDA13	CC-SS-7
MHDA17	CC-SS-8
MHDA18	CC-SS-9
MHDA06	CC-SS-10
MHDA07	CC-SS-11
MHDA08	CC-SS-12

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EPA SAMPLE NO.

MHCZ85

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW 8

Matrix (soil/water): WATER Lab Sample ID: MHCZ85

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	130	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	106	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	29100			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	14.2	B		P
7439-89-6	Iron	154			P
7439-92-1	Lead	3.0			P
7439-95-4	Magnesium	8220			P
7439-96-5	Manganese	48.8			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	2530	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	4.8	B		P
7440-66-6	Zinc	127			P
	Cyanide				NR

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ87

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW-7

Matrix (soil/water): WATER Lab Sample ID: MHCZ87

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	72.5	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	89.0	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	20900			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	15.3	B		P
7439-89-6	Iron	98.2	B		P
7439-92-1	Lead	2.4	B		P
7439-95-4	Magnesium	5720			P
7439-96-5	Manganese	108			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1580	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	5.5	B		P
7440-66-6	Zinc	215			P
	Cyanide				NR

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ89

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ85

SW-6

Matrix (soil/water): WATER Lab Sample ID: MHCZ89

Level (low/med): LOW Date Received: 08/04/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	74.0	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	103	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	21400			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	7.5	B		P
7439-89-6	Iron	94.7	B		P
7439-92-1	Lead	1.2	U		P
7439-95-4	Magnesium	5930			P
7439-96-5	Manganese	44.5			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1510	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	75.0			P
	Cyanide				NR

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ91

Lab Name: QUANTERRA_MO______________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW-S

Matrix (soil/water): WATER Lab Sample ID: MHCZ91

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_	44.8	B		P_
7440-36-0	Antimony_	45.9	U		P_
7440-38-2	Arsenic__	2.3	U		P_
7440-39-3	Barium___	27.5	B		P_
7440-41-7	Beryllium	0.50	U		P_
7440-43-9	Cadmium__	3.9	B		P_
7440-70-2	Calcium__	17600			P_
7440-47-3	Chromium_	2.8	U		P_
7440-48-4	Cobalt___	4.3	U		P_
7440-50-8	Copper___	58.9	_		P_
7439-89-6	Iron_____	101	_		P_
7439-92-1	Lead_____	12.5	_		P_
7439-95-4	Magnesium	5410	_		P_
7439-96-5	Manganese	485	_		P_
7439-97-6	Mercury__	0.10	U		CV
7440-02-0	Nickel___	14.2	U		P_
7440-09-7	Potassium	1060	U		P_
7782-49-2	Selenium_	2.9	U		P_
7440-22-4	Silver___	2.2	U		P_
7440-23-5	Sodium___	2400	B		P_
7440-28-0	Thallium_	3.3	U		P_
7440-62-2	Vanadium_	3.8	U		P_
7440-66-6	Zinc_____	1010	_		P_
	Cyanide__		_		NR

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EPA SAMPLE NO.

MHCZ93

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ85

Matrix (soil/water): WATER Lab Sample ID: MHCZ93

Level (low/med): LOW Date Received: 08/04/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	86.5	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	32.5	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	7.7			P
7440-70-2	Calcium	22100			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	94.2			P
7439-89-6	Iron	185			P
7439-92-1	Lead	22.8			P
7439-95-4	Magnesium	6850			P
7439-96-5	Manganese	763			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	3010	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	1470			P
	Cyanide				NR

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EPA SAMPLE NO.

MHCZ95

Lab Name: QUANTERRA_MO____________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SCW

Matrix (soil/water): WATER Lab Sample ID: MHCZ95

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_	57.4	B		P_
7440-36-0	Antimony_	45.9	U		P_
7440-38-2	Arsenic__	2.3	U		P_
7440-39-3	Barium___	14.8	B		P_
7440-41-7	Beryllium	0.50	U		P_
7440-43-9	Cadmium__	3.1	U		P_
7440-70-2	Calcium__	15400			P_
7440-47-3	Chromium_	2.8	U		P_
7440-48-4	Cobalt___	4.3	U		P_
7440-50-8	Copper___	8.3	B		P_
7439-89-6	Iron_____	116			P_
7439-92-1	Lead_____	1.9	B		P_
7439-95-4	Magnesium	5190			P_
7439-96-5	Manganese	23.5			P_
7439-97-6	Mercury__	0.10	U		CV
7440-02-0	Nickel___	14.2	U		P_
7440-09-7	Potassium	1060	U		P_
7782-49-2	Selenium_	2.9	U		P_
7440-22-4	Silver___	2.2	U		P_
7440-23-5	Sodium___	1880	B		P_
7440-28-0	Thallium_	3.3	U		P_
7440-62-2	Vanadium_	3.8	U		P_
7440-66-6	Zinc_____	575			P_
	Cyanide__				NR

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EPA SAMPLE NO.

MHCZ97

Lab Name: QUANTERRA_MO ________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW 2

Matrix (soil/water): WATER Lab Sample ID: MHCZ97

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	91.3	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	31.0	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	9.8			P
7440-70-2	Calcium	18800			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	109			P
7439-89-6	Iron	151			P
7439-92-1	Lead	24.1			P
7439-95-4	Magnesium	5510			P
7439-96-5	Manganese	911			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	2670	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	1480			P
	Cyanide				NR

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EPA SAMPLE NO.

MHCZ99

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW-1

Matrix (soil/water): WATER Lab Sample ID: MHCZ99

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	32.6	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	16.1	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	9660			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	12.3	B		P
7439-89-6	Iron	50.6	B		P
7439-92-1	Lead	1.2	U		P
7439-95-4	Magnesium	3470	B		P
7439-96-5	Manganese	4.7	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1560	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	9.7	B		P
	Cyanide				NR

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EPA SAMPLE NO.

MHDA05

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 SW-9

Matrix (soil/water): WATER Lab Sample ID: MHDA05

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	30.1	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	3.6	B		P
7440-41-7	Beryllium	0.54	B		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	2050	B		P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	7.8	B		P
7439-89-6	Iron	44.2	B		P
7439-92-1	Lead	1.2	U		P
7439-95-4	Magnesium	400	B		P
7439-96-5	Manganese	3.5	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	3.9	B		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	408	B		P
7440-28-0	Thallium	4.5	B		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	9.4	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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1
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA04

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ85 SCU

Matrix (soil/water): WATER Lab Sample ID: MHDA04

Level (low/med): LOW Date Received: 08/04/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	32.9	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	3.1	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	2190	B		P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	7.7	B		P
7439-89-6	Iron	42.2	B		P
7439-92-1	Lead	1.2	U		P
7439-95-4	Magnesium	396	B		P
7439-96-5	Manganese	3.5	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	413	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	11.9	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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1
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ98

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SD

Matrix (soil/water): SOIL Lab Sample ID: MHCZ98

Level (low/med): LOW Date Received: 08/04/95

% Solids: 71.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4910			P
7440-36-0	Antimony	12.9	U		P
7440-38-2	Arsenic	60.3			P
7440-39-3	Barium	640			P
7440-41-7	Beryllium	0.95	B		P
7440-43-9	Cadmium	21.6		*	P
7440-70-2	Calcium	4560			P
7440-47-3	Chromium	18.5			P
7440-48-4	Cobalt	14.3			P
7440-50-8	Copper	3840		N*	P
7439-89-6	Iron	48000		*	P
7439-92-1	Lead	7700		*	P
7439-95-4	Magnesium	3700			P
7439-96-5	Manganese	5080			P
7439-97-6	Mercury	0.07	U		CV
7440-02-0	Nickel	13.9			P
7440-09-7	Potassium	2500			P
7782-49-2	Selenium	0.82	U		P
7440-22-4	Silver	49.5			P
7440-23-5	Sodium	102	B		P
7440-28-0	Thallium	0.93	U		P
7440-62-2	Vanadium	43.5			P
7440-66-6	Zinc	2430			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA00

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86

SD-1

Matrix (soil/water): SOIL Lab Sample ID: MHDA00

Level (low/med): LOW Date Received: 08/04/95

% Solids: 78.2

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10900			P
7440-36-0	Antimony	11.7	U		P
7440-38-2	Arsenic	5.9			P
7440-39-3	Barium	93.6			P
7440-41-7	Beryllium	0.72	B		P
7440-43-9	Cadmium	1.3		*	P
7440-70-2	Calcium	4660			P
7440-47-3	Chromium	29.5			P
7440-48-4	Cobalt	11.9	B		P
7440-50-8	Copper	18.0		N*	P
7439-89-6	Iron	27300		*	P
7439-92-1	Lead	45.1		*	P
7439-95-4	Magnesium	6900			P
7439-96-5	Manganese	289			P
7439-97-6	Mercury	0.06	U		CV
7440-02-0	Nickel	12.6			P
7440-09-7	Potassium	1180	B		P
7782-49-2	Selenium	0.87	B		P
7440-22-4	Silver	1.8	B		P
7440-23-5	Sodium	158	B		P
7440-28-0	Thallium	0.84	U		P
7440-62-2	Vanadium	84.5			P
7440-66-6	Zinc	96.3			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ96

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SD-3

Matrix (soil/water): SOIL Lab Sample ID: MHCZ96

Level (low/med): LOW Date Received: 08/04/95

% Solids: 63.3

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11200			P
7440-36-0	Antimony	14.5	U		P
7440-38-2	Arsenic	42.5			P
7440-39-3	Barium	484			P
7440-41-7	Beryllium	2.0			P
7440-43-9	Cadmium	24.2		*	P
7440-70-2	Calcium	4500			P
7440-47-3	Chromium	30.2			P
7440-48-4	Cobalt	21.4			P
7440-50-8	Copper	72.0		N*	P
7439-89-6	Iron	30100		*	P
7439-92-1	Lead	363		*	P
7439-95-4	Magnesium	6150			P
7439-96-5	Manganese	6000			P
7439-97-6	Mercury	0.08	U		CV
7440-02-0	Nickel	53.8			P
7440-09-7	Potassium	1800			P
7782-49-2	Selenium	0.92	U		P
7440-22-4	Silver	13.4			P
7440-23-5	Sodium	115	B		P
7440-28-0	Thallium	1.0	B		P
7440-62-2	Vanadium	32.8			P
7440-66-6	Zinc	4280			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1
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EPA SAMPLE NO.

MHCZ94

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: ______ SDG No.: MHCZ86 SO-4

Matrix (soil/water): SOIL Lab Sample ID: MHCZ94

Level (low/med): LOW Date Received: 08/04/95

% Solids: 78.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9450			P
7440-36-0	Antimony	11.8	U		P
7440-38-2	Arsenic	31.6			P
7440-39-3	Barium	150			P
7440-41-7	Beryllium	1.9			P
7440-43-9	Cadmium	18.9		*	P
7440-70-2	Calcium	2980			P
7440-47-3	Chromium	21.8			P
7440-48-4	Cobalt	22.6			P
7440-50-8	Copper	334		N*	P
7439-89-6	Iron	30800		*	P
7439-92-1	Lead	1030		*	P
7439-95-4	Magnesium	5900			P
7439-96-5	Manganese	5430			P
7439-97-6	Mercury	0.06	U		CV
7440-02-0	Nickel	42.0			P
7440-09-7	Potassium	1870			P
7782-49-2	Selenium	0.74	U		P
7440-22-4	Silver	7.8			P
7440-23-5	Sodium	110	B		P
7440-28-0	Thallium	0.85	U		P
7440-62-2	Vanadium	57.4			P
7440-66-6	Zinc	2760			P

Color Before: BROWN Clarity Before: ______ Texture: MEDIUM

Color After: YELLOW Clarity After: ______ Artifacts: ______

Comments:

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1
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ92

SD. 5

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86

Matrix (soil/water): SOIL Lab Sample ID: MHCZ92

Level (low/med): LOW Date Received: 08/04/95

% Solids: 78.6

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6110			P
7440-36-0	Antimony	11.7	U		P
7440-38-2	Arsenic	36.6			P
7440-39-3	Barium	538			P
7440-41-7	Beryllium	1.3			P
7440-43-9	Cadmium	15.1		*	P
7440-70-2	Calcium	3910			P
7440-47-3	Chromium	37.2			P
7440-48-4	Cobalt	17.5			P
7440-50-8	Copper	2350		N*	P
7439-89-6	Iron	56800		*	P
7439-92-1	Lead	4450		*	P
7439-95-4	Magnesium	4330			P
7439-96-5	Manganese	4020			P
7439-97-6	Mercury	0.06	U		CV
7440-02-0	Nickel	15.0			P
7440-09-7	Potassium	1890			P
7782-49-2	Selenium	0.74	U		P
7440-22-4	Silver	27.8			P
7440-23-5	Sodium	139	B		P
7440-28-0	Thallium	0.84	U		P
7440-62-2	Vanadium	160			P
7440-66-6	Zinc	1990			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ90

50-

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: ______ SDG No.: MHCZ86

Matrix (soil/water): SOIL Lab Sample ID: MHCZ90

Level (low/med): LOW Date Received: 08/04/95

% Solids: 78.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7100			P
7440-36-0	Antimony	11.7	U		P
7440-38-2	Arsenic	12.9			P
7440-39-3	Barium	963			P
7440-41-7	Beryllium	0.64	B		P
7440-43-9	Cadmium	4.3		*	P
7440-70-2	Calcium	2180			P
7440-47-3	Chromium	16.1			P
7440-48-4	Cobalt	84.8			P
7440-50-8	Copper	28.3		N*	P
7439-89-6	Iron	26600		*	P
7439-92-1	Lead	507		*	P
7439-95-4	Magnesium	4910			P
7439-96-5	Manganese	1920			P
7439-97-6	Mercury	0.06	U		CV
7440-02-0	Nickel	17.8			P
7440-09-7	Potassium	1390			P
7782-49-2	Selenium	0.74	U		P
7440-22-4	Silver	5.9			P
7440-23-5	Sodium	76.3	B		P
7440-28-0	Thallium	0.91	B		P
7440-62-2	Vanadium	14.7			P
7440-66-6	Zinc	774			P

Color Before: BROWN Clarity Before: ______ Texture: MEDIUM

Color After: YELLOW Clarity After: ______ Artifacts: ______

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ88

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SD-7

Matrix (soil/water): SOIL Lab Sample ID: MHCZ88

Level (low/med): LOW Date Received: 08/04/95

% Solids: 72.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6960			P
7440-36-0	Antimony	12.8	U		P
7440-38-2	Arsenic	48.9			P
7440-39-3	Barium	1950			P
7440-41-7	Beryllium	0.64	B		P
7440-43-9	Cadmium	7.3		*	P
7440-70-2	Calcium	2100			P
7440-47-3	Chromium	17.1			P
7440-48-4	Cobalt	10.5	B		P
7440-50-8	Copper	34.0		N*	P
7439-89-6	Iron	34800		*	P
7439-92-1	Lead	969		*	P
7439-95-4	Magnesium	6290			P
7439-96-5	Manganese	13900			P
7439-97-6	Mercury	0.07	U		CV
7440-02-0	Nickel	23.7			P
7440-09-7	Potassium	1720			P
7782-49-2	Selenium	0.81	U		P
7440-22-4	Silver	17.4			P
7440-23-5	Sodium	63.3	B		P
7440-28-0	Thallium	1.6	B		P
7440-62-2	Vanadium	14.7			P
7440-66-6	Zinc	1570			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHCZ86

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 50-9

Matrix (soil/water): SOIL Lab Sample ID: MHCZ86

Level (low/med): LOW Date Received: 08/04/95

% Solids: 68.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6890			P
7440-36-0	Antimony	13.4	U		P
7440-38-2	Arsenic	24.6			P
7440-39-3	Barium	567			P
7440-41-7	Beryllium	0.86	B		P
7440-43-9	Cadmium	6.3		*	P
7440-70-2	Calcium	6960			P
7440-47-3	Chromium	28.4			P
7440-48-4	Cobalt	10.3	B		P
7440-50-8	Copper	310		N*	P
7439-89-6	Iron	28700		*	P
7439-92-1	Lead	782		*	P
7439-95-4	Magnesium	5430			P
7439-96-5	Manganese	2000			P
7439-97-6	Mercury	0.07	U		CV
7440-02-0	Nickel	19.6			P
7440-09-7	Potassium	1880			P
7782-49-2	Selenium	0.85	U		P
7440-22-4	Silver	9.5			P
7440-23-5	Sodium	123	B		P
7440-28-0	Thallium	0.96	U		P
7440-62-2	Vanadium	65.1			P
7440-66-6	Zinc	1100			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA20

Lab Name: QUANTERRA_MO______________ Contract: 68D30049__

GW-1

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85

Matrix (soil/water): WATER Lab Sample ID: MHDA20

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	96.2	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	69.2	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	3510	B		P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	9.0	B		P
7439-89-6	Iron	97.3	B		P
7439-92-1	Lead	19.5			P
7439-95-4	Magnesium	1280	B		P
7439-96-5	Manganese	3.7	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	651	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	28.5			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA02

Lab Name: QUANTERRA_MO Contract: 68D30049__

GW:

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85

Matrix (soil/water): WATER Lab Sample ID: MHDA02

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	32.7	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	28.9	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	48300			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	24.8	B		P
7439-89-6	Iron	283			P
7439-92-1	Lead	2.3	B		P
7439-95-4	Magnesium	6590			P
7439-96-5	Manganese	11.2	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	3660	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	4.1	B		P
7440-66-6	Zinc	70.0			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA16

Lab Name: QUANTERRA_MO______________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 GW-4

Matrix (soil/water): WATER Lab Sample ID: MHDA16

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	142	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	6.6	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	18100			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	12.1	B		P
7439-89-6	Iron	978			P
7439-92-1	Lead	2.6	B		P
7439-95-4	Magnesium	3930	B		P
7439-96-5	Manganese	189			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1690	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	3.8	U		P
7440-66-6	Zinc	464			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

1
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA11

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 GW-5

Matrix (soil/water): WATER Lab Sample ID: MHDA11

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	55.3	B		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	8.1	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	9940			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	8.7	B		P
7439-89-6	Iron	109			P
7439-92-1	Lead	1.2	U		P
7439-95-4	Magnesium	2390	B		P
7439-96-5	Manganese	25.0			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1170	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	4.0	B		P
7440-66-6	Zinc	9.1	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA03

GW.

Lab Name: QUANTERRA_MO_____________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85

Matrix (soil/water): WATER Lab Sample ID: MHDA03

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	24.6	U		P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	23.3	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	39200			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	75.7			P
7439-89-6	Iron	323			P
7439-92-1	Lead	3.4			P
7439-95-4	Magnesium	5390			P
7439-96-5	Manganese	13.9	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	2950	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	7.2	B		P
7440-66-6	Zinc	80.3			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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1
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EPA SAMPLE NO.

MHDA09

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ85 GW

Matrix (soil/water): WATER Lab Sample ID: MHDA09

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	411			P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	12.0	B		P
7440-41-7	Beryllium	0.50	U		P
7440-43-9	Cadmium	3.1	U		P
7440-70-2	Calcium	14800			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	4.3	U		P
7440-50-8	Copper	16.4	B		P
7439-89-6	Iron	1290			P
7439-92-1	Lead	11.7			P
7439-95-4	Magnesium	4620	B		P
7439-96-5	Manganese	111			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.2	U		P
7440-09-7	Potassium	1060	U		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	1850	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	5.5	B		P
7440-66-6	Zinc	107			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: ______

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ______

Comments:

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1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA19

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ85 GW5

Matrix (soil/water): WATER Lab Sample ID: MHDA19

Level (low/med): LOW Date Received: 08/04/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2500			P
7440-36-0	Antimony	45.9	U		P
7440-38-2	Arsenic	2.3	U		P
7440-39-3	Barium	21.0	B		P
7440-41-7	Beryllium	14.6			P
7440-43-9	Cadmium	50.6			P
7440-70-2	Calcium	70800			P
7440-47-3	Chromium	2.8	U		P
7440-48-4	Cobalt	39.2	B		P
7440-50-8	Copper	139			P
7439-89-6	Iron	4490			P
7439-92-1	Lead	180			P
7439-95-4	Magnesium	7580			P
7439-96-5	Manganese	1540			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	28.9	B		P
7440-09-7	Potassium	1650	B		P
7782-49-2	Selenium	2.9	U		P
7440-22-4	Silver	2.2	U		P
7440-23-5	Sodium	9630			P
7440-28-0	Thallium	6.0	B		P
7440-62-2	Vanadium	8.1	B		P
7440-66-6	Zinc	7040			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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EPA SAMPLE NO.

MHDA01

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SS-1

Matrix (soil/water): SOIL Lab Sample ID: MHDA01

Level (low/med): LOW Date Received: 08/04/95

% Solids: 31.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1370			P
7440-36-0	Antimony	29.2	U		P
7440-38-2	Arsenic	3.2	B		P
7440-39-3	Barium	44.6	B		P
7440-41-7	Beryllium	0.32	U		P
7440-43-9	Cadmium	2.9	B	*	P
7440-70-2	Calcium	5250			P
7440-47-3	Chromium	1.8	U		P
7440-48-4	Cobalt	2.7	U		P
7440-50-8	Copper	28.4		N*	P
7439-89-6	Iron	1690		*	P
7439-92-1	Lead	53.2		*	P
7439-95-4	Magnesium	969	B		P
7439-96-5	Manganese	238			P
7439-97-6	Mercury	0.16	U		CV
7440-02-0	Nickel	9.0	U		P
7440-09-7	Potassium	849	B		P
7782-49-2	Selenium	1.8	U		P
7440-22-4	Silver	2.5	B		P
7440-23-5	Sodium	140	B		P
7440-28-0	Thallium	2.1	U		P
7440-62-2	Vanadium	3.1	B		P
7440-66-6	Zinc	156			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1

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EPA SAMPLE NO.

MHDA14

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SS-2

Matrix (soil/water): SOIL Lab Sample ID: MHDA14

Level (low/med): LOW Date Received: 08/04/95

% Solids: 93.2

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	729			P
7440-36-0	Antimony	49.2	U		P
7440-38-2	Arsenic	104			P
7440-39-3	Barium	15.0	B		P
7440-41-7	Beryllium	0.26	B		P
7440-43-9	Cadmium	6.5		*	P
7440-70-2	Calcium	20400			P
7440-47-3	Chromium	7.7	B		P
7440-48-4	Cobalt	4.6	U		P
7440-50-8	Copper	49.3		N*	P
7439-89-6	Iron	167000		*	P
7439-92-1	Lead	2380		*	P
7439-95-4	Magnesium	455	B		P
7439-96-5	Manganese	31.5			P
7439-97-6	Mercury	0.07	B		CV
7440-02-0	Nickel	3.0	U		P
7440-09-7	Potassium	1120			P
7782-49-2	Selenium	0.62	U		P
7440-22-4	Silver	37.6			P
7440-23-5	Sodium	77.2	B		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	4.1	U		P
7440-66-6	Zinc	1120			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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1

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EPA SAMPLE NO.

MHDA15

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 SS-3

Matrix (soil/water): SOIL Lab Sample ID: MHDA15

Level (low/med): LOW Date Received: 08/04/95

% Solids: 93.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3020			P
7440-36-0	Antimony	35.6			P
7440-38-2	Arsenic	46.6			P
7440-39-3	Barium	46.6			P
7440-41-7	Beryllium	1.2			P
7440-43-9	Cadmium	6.7		*	P
7440-70-2	Calcium	267	B		P
7440-47-3	Chromium	2.2			P
7440-48-4	Cobalt	0.92	U		P
7440-50-8	Copper	89.5		N*	P
7439-89-6	Iron	19000		*	P
7439-92-1	Lead	5270		*	P
7439-95-4	Magnesium	139	B		P
7439-96-5	Manganese	14.3			P
7439-97-6	Mercury	0.83			CV
7440-02-0	Nickel	3.1	U		P
7440-09-7	Potassium	1500			P
7782-49-2	Selenium	0.62	U		P
7440-22-4	Silver	51.0			P
7440-23-5	Sodium	58.6	B		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	2.4	B		P
7440-66-6	Zinc	1360			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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EPA SAMPLE NO.

MHDA10

55-9

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ86

Matrix (soil/water): SOIL_ Lab Sample ID: MHDA10

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: _81.6

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6100			P
7440-36-0	Antimony	11.2	U		P
7440-38-2	Arsenic	183			P
7440-39-3	Barium	121			P
7440-41-7	Beryllium	0.83	B		P
7440-43-9	Cadmium	2.3		*	P
7440-70-2	Calcium	4150			P
7440-47-3	Chromium	49.4			P
7440-48-4	Cobalt	15.8			P
7440-50-8	Copper	59.9		N*	P
7439-89-6	Iron	50800		*	P
7439-92-1	Lead	177		*	P
7439-95-4	Magnesium	3820			P
7439-96-5	Manganese	1050			P
7439-97-6	Mercury	0.06	U		CV
7440-02-0	Nickel	48.5			P
7440-09-7	Potassium	3040			P
7782-49-2	Selenium	0.71	U		P
7440-22-4	Silver	9.3			P
7440-23-5	Sodium	94.2	B		P
7440-28-0	Thallium	1.0	B		P
7440-62-2	Vanadium	37.5			P
7440-66-6	Zinc	472			P

Color Before: BROWN___ Clarity Before: ______ Texture: MEDIUM

Color After: YELLOW___ Clarity After: ______ Artifacts: ______

Comments:

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1
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EPA SAMPLE NO.

MHDA12

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 55-6

Matrix (soil/water): SOIL Lab Sample ID: MHDA12

Level (low/med): LOW Date Received: 08/04/95

% Solids: 91.3

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4060			P
7440-36-0	Antimony	62.9			P
7440-38-2	Arsenic	280			P
7440-39-3	Barium	87.7			P
7440-41-7	Beryllium	0.64	B		P
7440-43-9	Cadmium	2.3		*	P
7440-70-2	Calcium	899	B		P
7440-47-3	Chromium	11.0			P
7440-48-4	Cobalt	2.7	B		P
7440-50-8	Copper	308		N*	P
7439-89-6	Iron	42400		*	P
7439-92-1	Lead	5020		*	P
7439-95-4	Magnesium	1350			P
7439-96-5	Manganese	108			P
7439-97-6	Mercury	0.49			CV
7440-02-0	Nickel	5.0	B		P
7440-09-7	Potassium	3100			P
7782-49-2	Selenium	0.64	U		P
7440-22-4	Silver	125			P
7440-23-5	Sodium	141	B		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	12.8			P
7440-66-6	Zinc	472			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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EPA SAMPLE NO.

MHDA13

55-7

Lab Name: QUANTERRA_MO Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ86

Matrix (soil/water): SOIL_ Lab Sample ID: MHDA13

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: _91.8

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4660			P
7440-36-0	Antimony	18.1			P
7440-38-2	Arsenic	112			P
7440-39-3	Barium	57.3			P
7440-41-7	Beryllium	0.36	B		P
7440-43-9	Cadmium	1.7		*	P
7440-70-2	Calcium	1490			P
7440-47-3	Chromium	14.6			P
7440-48-4	Cobalt	4.5	B		P
7440-50-8	Copper	181		N*	P
7439-89-6	Iron	48500		*	P
7439-92-1	Lead	1180		*	P
7439-95-4	Magnesium	3150			P
7439-96-5	Manganese	272			P
7439-97-6	Mercury	2.8			CV
7440-02-0	Nickel	3.6	B		P
7440-09-7	Potassium	2850			P
7782-49-2	Selenium	0.63	U		P
7440-22-4	Silver	36.9			P
7440-23-5	Sodium	89.2	B		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	13.2			P
7440-66-6	Zinc	255			P

Color Before: BROWN____ Clarity Before: ______ Texture: MEDIUM

Color After: YELLOW___ Clarity After: ______ Artifacts: ______

Comments:

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EPA SAMPLE NO.

MHDA17

Lab Name: QUANTERRA_MO Contract: 68D30049

35.8

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86

Matrix (soil/water): SOIL Lab Sample ID: MHDA17

Level (low/med): LOW Date Received: 08/04/95

% Solids: 86.2

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12000			P
7440-36-0	Antimony	16.8			P
7440-38-2	Arsenic	24.9			P
7440-39-3	Barium	473			P
7440-41-7	Beryllium	0.94	B		P
7440-43-9	Cadmium	4.2		*	P
7440-70-2	Calcium	2220			P
7440-47-3	Chromium	9.5			P
7440-48-4	Cobalt	9.5	B		P
7440-50-8	Copper	304		N*	P
7439-89-6	Iron	63500		*	P
7439-92-1	Lead	454		*	P
7439-95-4	Magnesium	11400			P
7439-96-5	Manganese	320			P
7439-97-6	Mercury	0.77			CV
7440-02-0	Nickel	7.3	B		P
7440-09-7	Potassium	11400			P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	5.4			P
7440-23-5	Sodium	209	B		P
7440-28-0	Thallium	0.77	U		P
7440-62-2	Vanadium	83.3			P
7440-66-6	Zinc	1080			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

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EPA SAMPLE NO.

MHDA18

Lab Name: QUANTERRA_MO   Contract: 68D30049

Lab Code: ITMO   Case No.: 23851   SAS No.:   SDG No.: MHCZ86 5s9

Matrix (soil/water): SOIL   Lab Sample ID: MHDA18

Level (low/med): LOW   Date Received: 08/04/95

% Solids: 92.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	583			P
7440-36-0	Antimony	82.1			P
7440-38-2	Arsenic	155			P
7440-39-3	Barium	24.2	B		P
7440-41-7	Beryllium	0.30	B		P
7440-43-9	Cadmium	40.5		*	P
7440-70-2	Calcium	240	B		P
7440-47-3	Chromium	0.61	U		P
7440-48-4	Cobalt	3.3	B		P
7440-50-8	Copper	201		N*	P
7439-89-6	Iron	20300		*	P
7439-92-1	Lead	2330		*	P
7439-95-4	Magnesium	102	B		P
7439-96-5	Manganese	19.7			P
7439-97-6	Mercury	0.40			CV
7440-02-0	Nickel	3.1	U		P
7440-09-7	Potassium	1010	B		P
7782-49-2	Selenium	0.63	U		P
7440-22-4	Silver	84.9			P
7440-23-5	Sodium	51.2	B		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	0.82	U		P
7440-66-6	Zinc	7690			P

Color Before: BROWN   Clarity Before: Texture: MEDIUM

Color After: YELLOW   Clarity After: Artifacts:

Comments:

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EPA SAMPLE NO.

MHDA06

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86 55-1

Matrix (soil/water): SOIL Lab Sample ID: MHDA06

Level (low/med): LOW Date Received: 08/04/95

% Solids: 87.9

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2570			P
7440-36-0	Antimony	10.7	B		P
7440-38-2	Arsenic	178			P
7440-39-3	Barium	24.0	B		P
7440-41-7	Beryllium	0.19	B		P
7440-43-9	Cadmium	8.0		*	P
7440-70-2	Calcium	935	B		P
7440-47-3	Chromium	17.0			P
7440-48-4	Cobalt	0.98	U		P
7440-50-8	Copper	63.7		N*	P
7439-89-6	Iron	93900		*	P
7439-92-1	Lead	4050		*	P
7439-95-4	Magnesium	1330			P
7439-96-5	Manganese	185			P
7439-97-6	Mercury	0.30			CV
7440-02-0	Nickel	3.2	U		P
7440-09-7	Potassium	1580			P
7782-49-2	Selenium	0.66	U		P
7440-22-4	Silver	18.7			P
7440-23-5	Sodium	74.4	B		P
7440-28-0	Thallium	0.75	U		P
7440-62-2	Vanadium	4.8	B		P
7440-66-6	Zinc	1780			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

FORM I - IN ILM03.0

RESUBMITTED DATA

0000013

U.S. EPA - CLP

1
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA07

Lab Name: QUANTERRA_MO Contract: 68D30049

Lab Code: ITMO Case No.: 23851 SAS No.: SDG No.: MHCZ86

Matrix (soil/water): SOIL Lab Sample ID: MHDA07

Level (low/med): LOW Date Received: 08/04/95

% Solids: 88.6

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14100			P
7440-36-0	Antimony	16.5			P
7440-38-2	Arsenic	156			P
7440-39-3	Barium	213			P
7440-41-7	Beryllium	0.76	B		P
7440-43-9	Cadmium	28.9		*	P
7440-70-2	Calcium	1500			P
7440-47-3	Chromium	191			P
7440-48-4	Cobalt	15.6			P
7440-50-8	Copper	172		N*	P
7439-89-6	Iron	61200		*	P
7439-92-1	Lead	14100		*	P
7439-95-4	Magnesium	14200			P
7439-96-5	Manganese	575			P
7439-97-6	Mercury	0.28			CV
7440-02-0	Nickel	69.1			P
7440-09-7	Potassium	4540			P
7782-49-2	Selenium	0.65	U		P
7440-22-4	Silver	41.0			P
7440-23-5	Sodium	294	B		P
7440-28-0	Thallium	0.74	U		P
7440-62-2	Vanadium	59.5			P
7440-66-6	Zinc	7480			P

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: Artifacts:

Comments:

FORM I - IN ILM03.0

RESUBMITTED DATA

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

MHDA08

Lab Name: QUANTERRA_MO______________ Contract: 68D30049__

Lab Code: ITMO__ Case No.: 23851_ SAS No.: ______ SDG No.: MHCZ86

55-1.

Matrix (soil/water): SOIL_ Lab Sample ID: MHDA08

Level (low/med): LOW__ Date Received: 08/04/95

% Solids: _92.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	889			P
7440-36-0	Antimony	9.9	U		P
7440-38-2	Arsenic	94.1			P
7440-39-3	Barium	36.9	B		P
7440-41-7	Beryllium	0.23	B		P
7440-43-9	Cadmium	18.1		*	P
7440-70-2	Calcium	243	B		P
7440-47-3	Chromium	1.3	B		P
7440-48-4	Cobalt	0.93	U		P
7440-50-8	Copper	32.3		N*	P
7439-89-6	Iron	16200		*	P
7439-92-1	Lead	4340		*	P
7439-95-4	Magnesium	116	B		P
7439-96-5	Manganese	6.6			P
7439-97-6	Mercury	3.4			CV
7440-02-0	Nickel	3.1	U		P
7440-09-7	Potassium	1740			P
7782-49-2	Selenium	0.63	U		P
7440-22-4	Silver	295			P
7440-23-5	Sodium	60.2	B		P
7440-28-0	Thallium	11.9			P
7440-62-2	Vanadium	0.82	U		P
7440-66-6	Zinc	3940			P

Color Before: BROWN____ Clarity Before: ______ Texture: MEDIUM

Color After: YELLOW___ Clarity After: ______ Artifacts: ______

Comments:

FORM I - IN ILM03.0

RESUBMITTED DATA

0000015

APPENDIX I

DATA VALIDATION RESULTS

PIONEER TECHNICAL SERVICES | INORGANIC TARGET ANALYTE LIST

SDG#: MHCZ85 | CASE NO.: 23851 | EPA METHOD#: SOW 3/90

CARPENTER CREEK - SITE INVESTIGATION

HOLDING TIMES:

All samples were prepared and analyzed within holding time.

CALIBRATIONS:

Initial Calibration Verification
1. All recoveries are acceptable
2. Raw data confirms

Continuing Calibration Verification
1. All recoveries are acceptable
2. Raw data confirms

BLANK ANALYSIS (PB, ICB, CCB):

PB
1. No target elements detected
2. Raw data confirms

ICB
1. No target elements detected
2. Raw data confirms

CCB
1. Barium, berylium and thallium > 2x IDL
2. All other elements acceptable
3. Raw data confirms

SPIKED SAMPLE ANALYSIS:

SSA
1. All elements acceptable
2. Raw data confirms

DUPLICATE SAMPLE ANALYSIS:

DSA
1. All elements meet precision goals
2. Raw data confirms

LABORATORY CONTROL SAMPLE:

LCS
1. All recoveries are acceptable
2. Raw data confirms

ICP INTERFERENCE CHECK SAMPLE (ICSA/ICSAB):

ICSA/ICSAB
1. No Antimony, Arsenic, Selenium, or Thallium determination
2. All other ICSA/ICSAB recoveries are acceptable
3. Raw data confirms

ICP SERIAL DILUTION:

SDL
1. All elemental precision acceptable
2. Raw data confirms

GFAA QA/QC & METHOD OF STANDARD ADDITIONS:

Not required - all elements quantified using either ICP or CVAA

INSTRUMENT DETECTION LIMITS:

All IDLs meet the goals of the project

PIONEER TECHNICAL SERVICES INORGANIC TARGET ANALYTE LIST

SDG#: MHCZ85 CASE NO.: 23851 EPA METHOD#: SOW 3/90

CARPENTER CREEK - SITE INVESTIGATION

CHAIN OF CUSTODY:

Complete

SAMPLE VERIFICATION:

Report forms accurately present the raw data.

OVERALL ASSESSMENT OF DATA:

Only minor problems affected the data in this SDG. Barium, beryllium and thallium were detected in continuing calibration blanks at levels greater than twice the instrument detection limit. Low level detections of barium and beryllium in samples MHDA04 and MHDA05 are flagged U and should be viewed as non detects. The remaining data can be used without further restrictions.

PIONEER TECHNICAL SERVICES INORGANIC TARGET ANALYTE LIST

SDG#: MHCZ86 CASE NO.: 23851 EPA METHOD#: SOW 3/90

CARPENTER CREEK - SITE INVESTIGATION

HOLDING TIMES:

All samples were prepared and analyzed within holding time.

CALIBRATIONS:

Initial Calibration Verification
1. All recoveries are acceptable
2. Raw data confirms

Continuing Calibration Verification
1. All recoveries are acceptable
2. Raw data confirms

BLANK ANALYSIS (PB, ICB, CCB):

PB
1. Barium, calcium, copper, magnesium, vanadium > 2x IDL
2. All other elements acceptable
3. Raw data confirms

ICB
1. Barium > 2x IDL
2. All other elements acceptable
3. Raw data confirms

CCB
1. Barium, beryllium, iron, manganese > 2x IDL
2. All other elements acceptable
3. Raw data confirms

SPIKED SAMPLE ANALYSIS:

SSA
1. Copper = 52.2 %Recovery
2. All other elements acceptable
3. Raw data confirms

PIONEER TECHNICAL SERVICES INORGANIC TARGET ANALYTE LIST

SDG#: MHCZ86 CASE NO.: 23851 EPA METHOD#: SOW 3/90

CARPENTER CREEK - SITE INVESTIGATION

DUPLICATE SAMPLE ANALYSIS:

DSA
1. Cadmium = 26%; copper = 31%; iron = 32.9%; lead = 22.1%
1. All other elements meet precision goals
2. Raw data confirms

LABORATORY CONTROL SAMPLE:

LCS
1. All recoveries are acceptable
2. Raw data confirms

ICP INTERFERENCE CHECK SAMPLE (ICSA/ICSAB):

ICSA/ICSAB
1. Check not performed for arsenic, antimony, and selenium
2. All other ICSA/ICSAB recoveries are acceptable
3. Raw data confirms

ICP SERIAL DILUTION:

SDL
1. All elemental precision acceptable
2. Raw data confirms

GFAA QA/QC & METHOD OF STANDARD ADDITIONS:

Not required - all elements quantified using either ICP or CVAA

INSTRUMENT DETECTION LIMITS:

All IDLs meet the goals of the project

PIONEER TECHNICAL SERVICES INORGANIC TARGET ANALYTE LIST

SDG#: MHCZ86 CASE NO.: 23851 EPA METHOD#: SOW 3/90

CARPENTER CREEK - SITE INVESTIGATION

CHAIN OF CUSTODY:

Complete

SAMPLE VERIFICATION:

Report forms accurately present the raw data.

OVERALL ASSESSMENT OF DATA:

Due to elevated levels of target analytes in preparation and continuing calibration blanks the following elements have been flagged U in the associated samples: magnesium in samples MHDA15 and MHDA18; vanadium in samples MHDAO1, MHDA06, and MHDA15; beryllium in all samples except MHCZ92, MHCZ94 and MHCZ96.

The digestion spike for copper fell out of control at 52.2%. Copper concentrations in each of the samples are greater than the IDL, therefore, no additional flages are required. Duplicate precision for cadmium, copper, iron, and lead exceeded the control limit of 20% RPD, however, Functional Guidelines allows expansion of these limits to 35% for soils. No further qualifications are necessary.

FIGURES

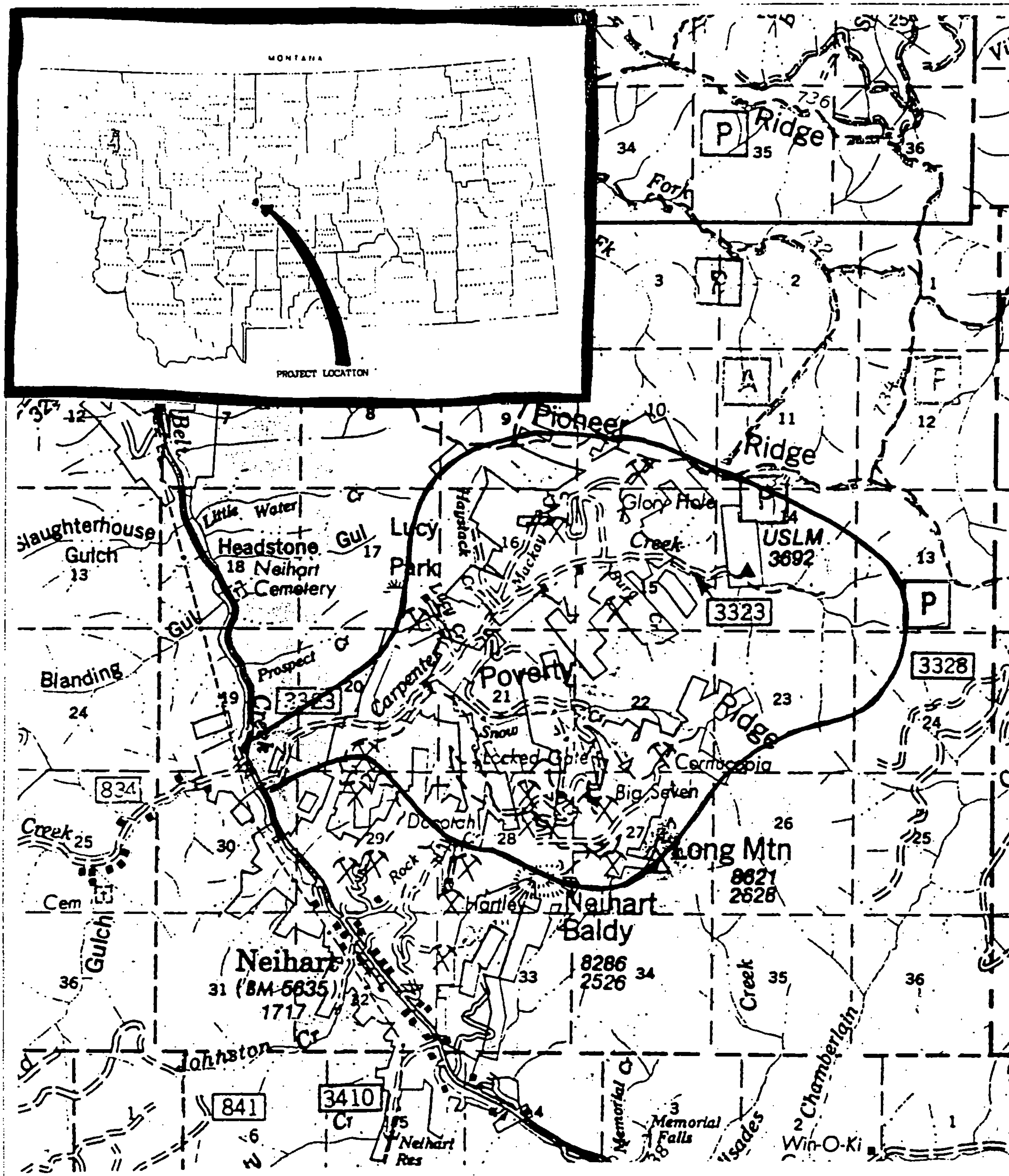
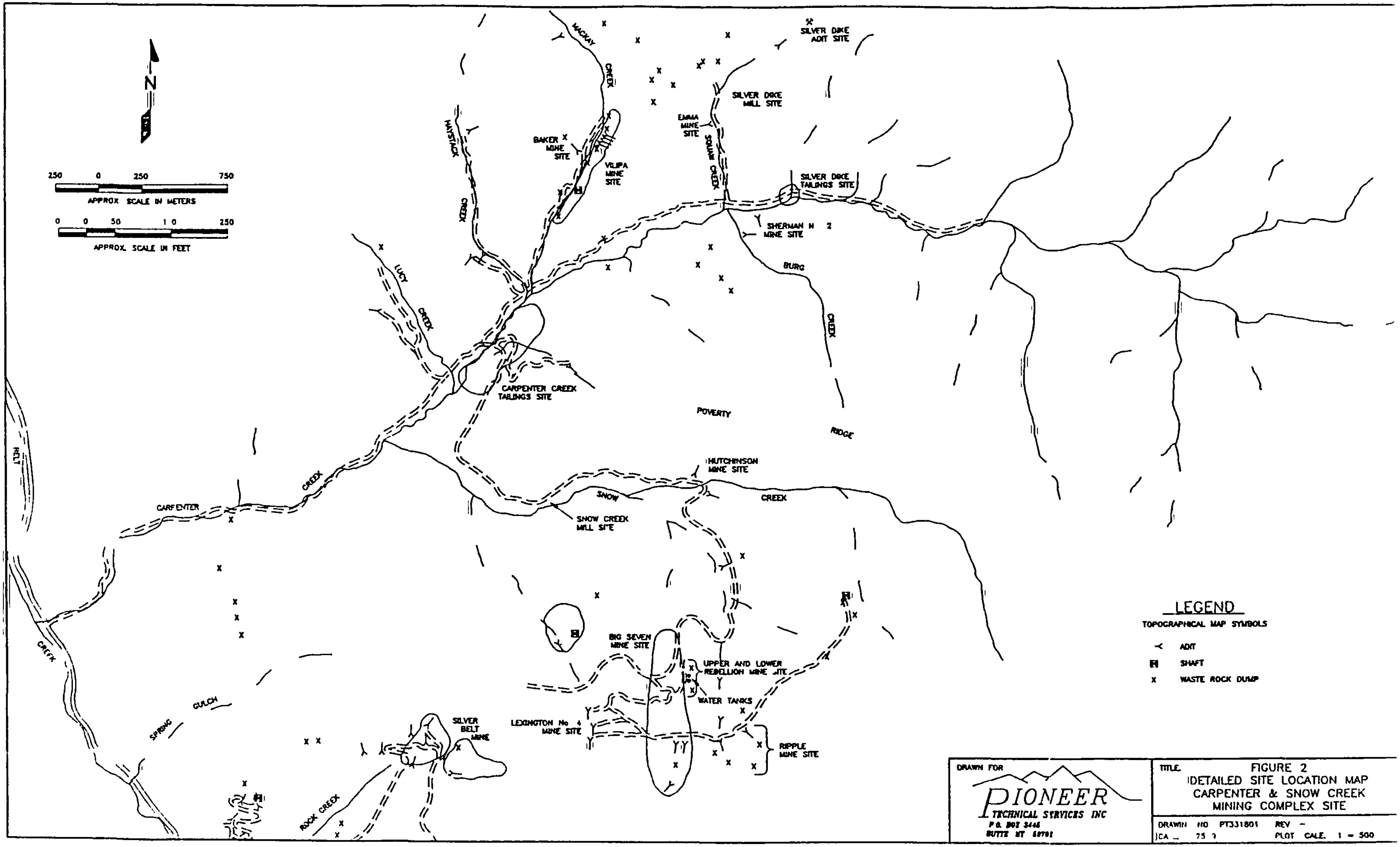


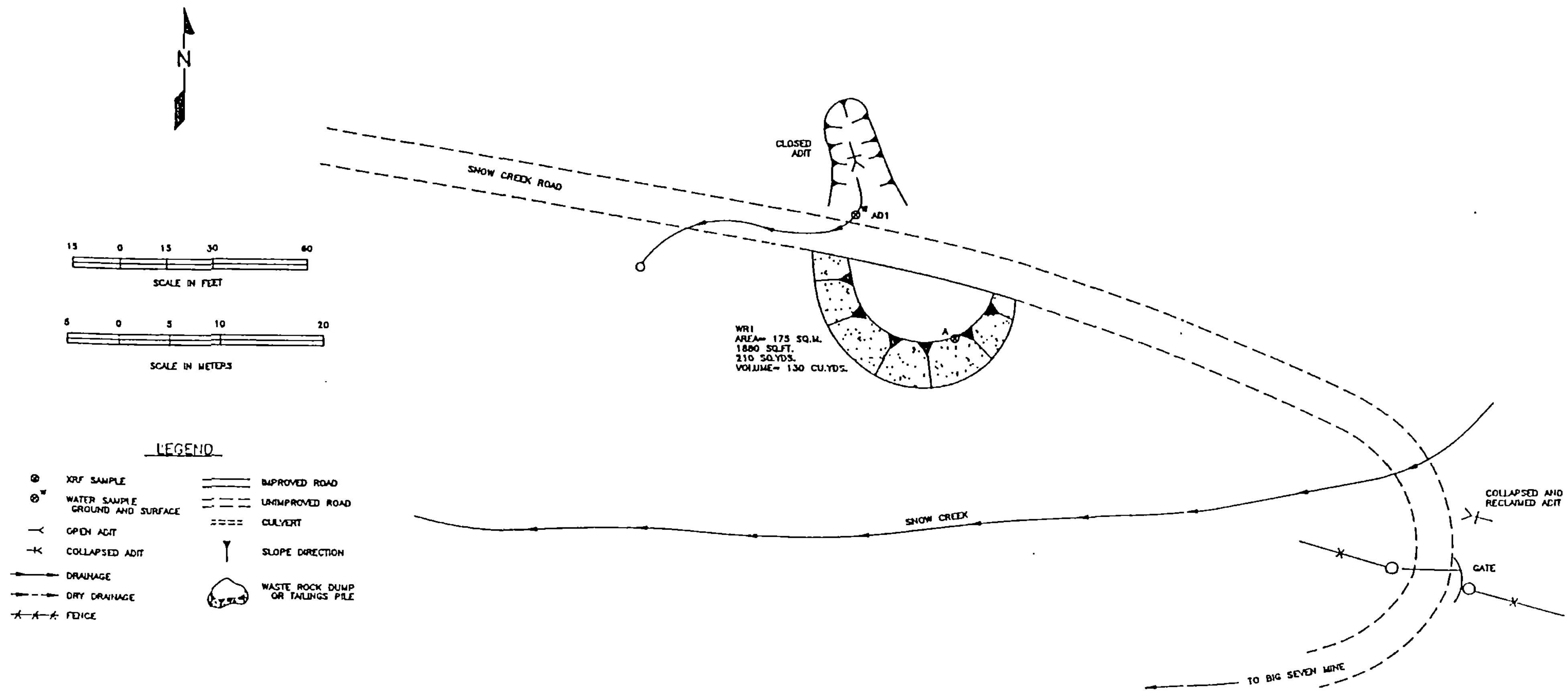
FIGURE 1
GENERAL SITE LOCATION MAP
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

N

PIONEER TECHNICAL SERVICES, INC.

USFS Lewis and Clark National Forest Map


N
250 0 250 750
APPROX SCALE IN METERS
0 0 50 1 0 250
APPROX. SCALE IN FEET
MACKAY CREEK
SILVER DIKE ADIT SITE
SILVER DIKE MILL SITE
EMMA MINE SITE
SQUAW CREEK
HAYSTACK CREEK
BAKER MINE SITE
VILIPA MINE SITE
SILVER DIKE TAILINGS SITE
SHERMAN N 2 MINE SITE
BURG CREEK
LUCY CREEK
CARPENTER CREEK TAILINGS SITE
POVERTY RIDGE
HUTCHINSON MINE SITE
SNOW CREEK
SNOW CREEK MILL SITE
CARPENTER CREEK
BELT CREEK
BIG SEVEN MINE SITE
UPPER AND LOWER REBELLION MINE SITE
WATER TANKS
LEXINGTON No 4 MINE SITE
RIPPLE MINE SITE
SILVER BELT MINE
SPRING GULCH
ROCK CREEK
LEGEND
TOPOGRAPHICAL MAP SYMBOLS
ADIT
SHAFT
WASTE ROCK DUMP
DRAWN FOR
PIONEER TECHNICAL SERVICES INC
P.O. BOX 3445
BUTTE MT 59702
TITLE
FIGURE 2
DETAILED SITE LOCATION MAP
CARPENTER & SNOW CREEK
MINING COMPLEX SITE
DRAWIN NO PT331801 REV -
PLOT CALE. 1 = 500

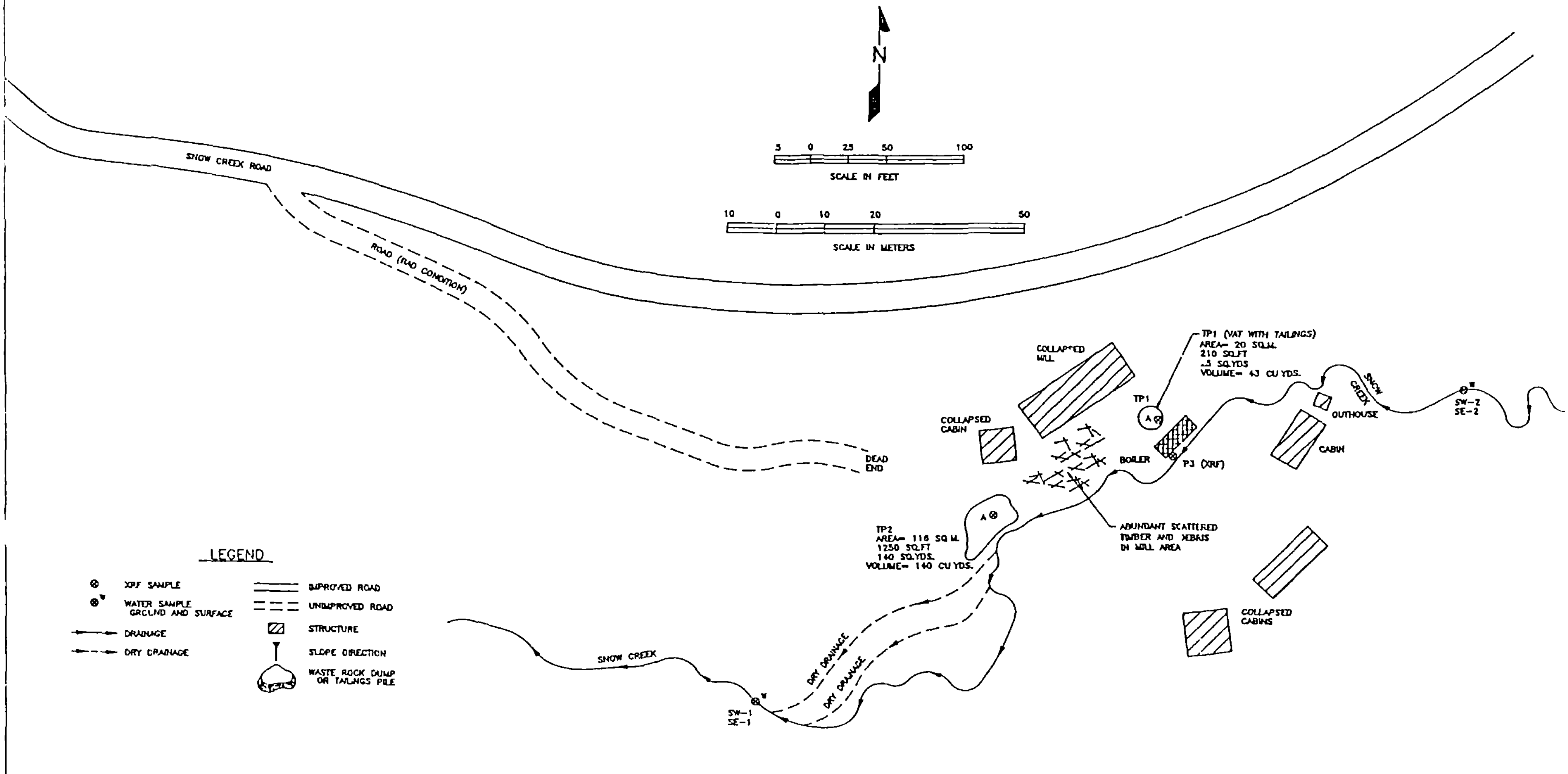


DRAWN FOR:

PIONEER TECHNICAL SERVICES, INC.

TITLE: FIGURE 3
DETAILED SITE LOCATION MAP
HUTCHINSON PA# 07-177
SOURCE 1994 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY

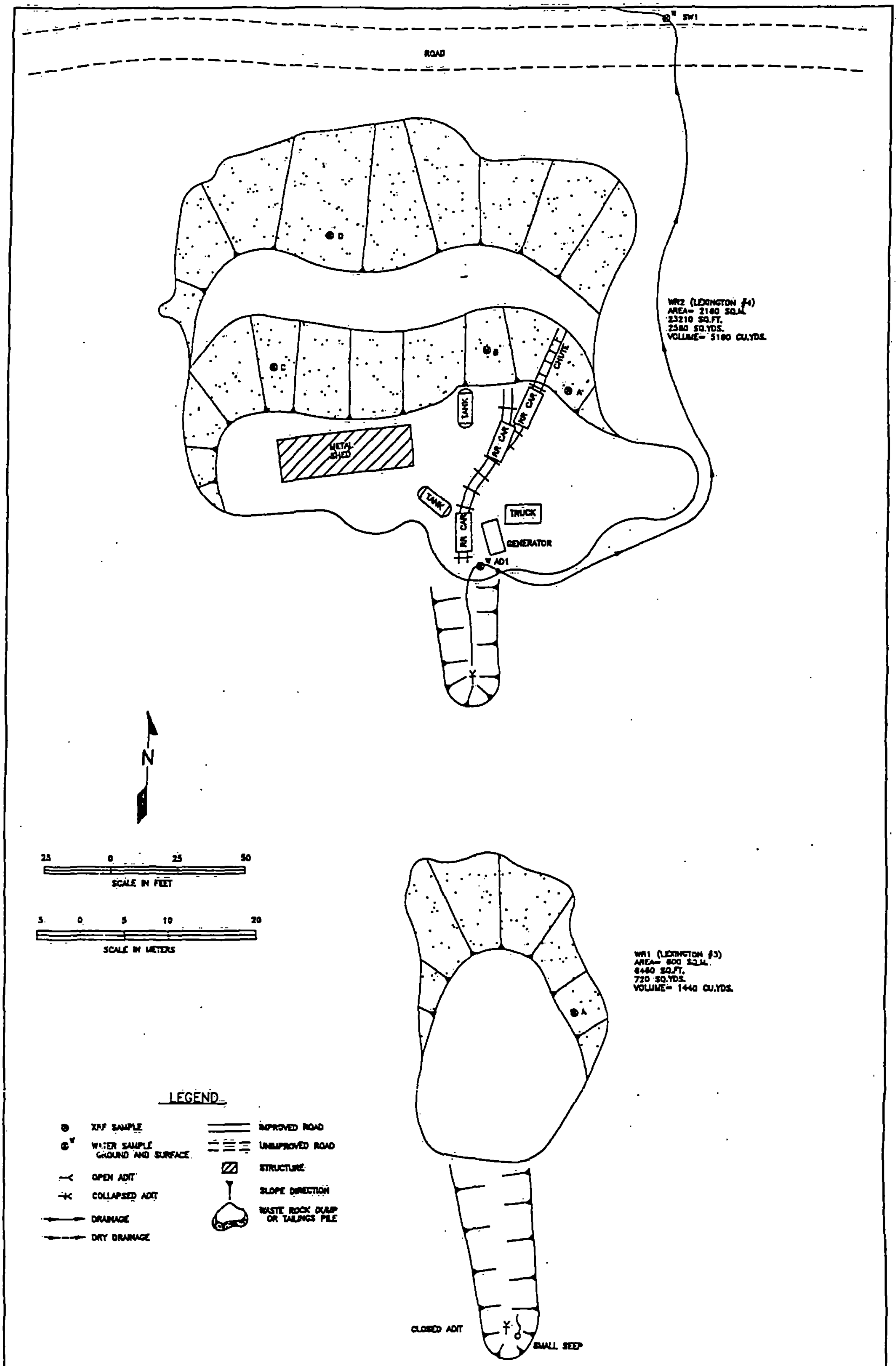
DRAWING NO.: PT340210 REV: –
DATE: 10/30/94 PLOT SCALE: 1 = 10



DRAWN FOR: PIONEER TECHNICAL SERVICES INC.

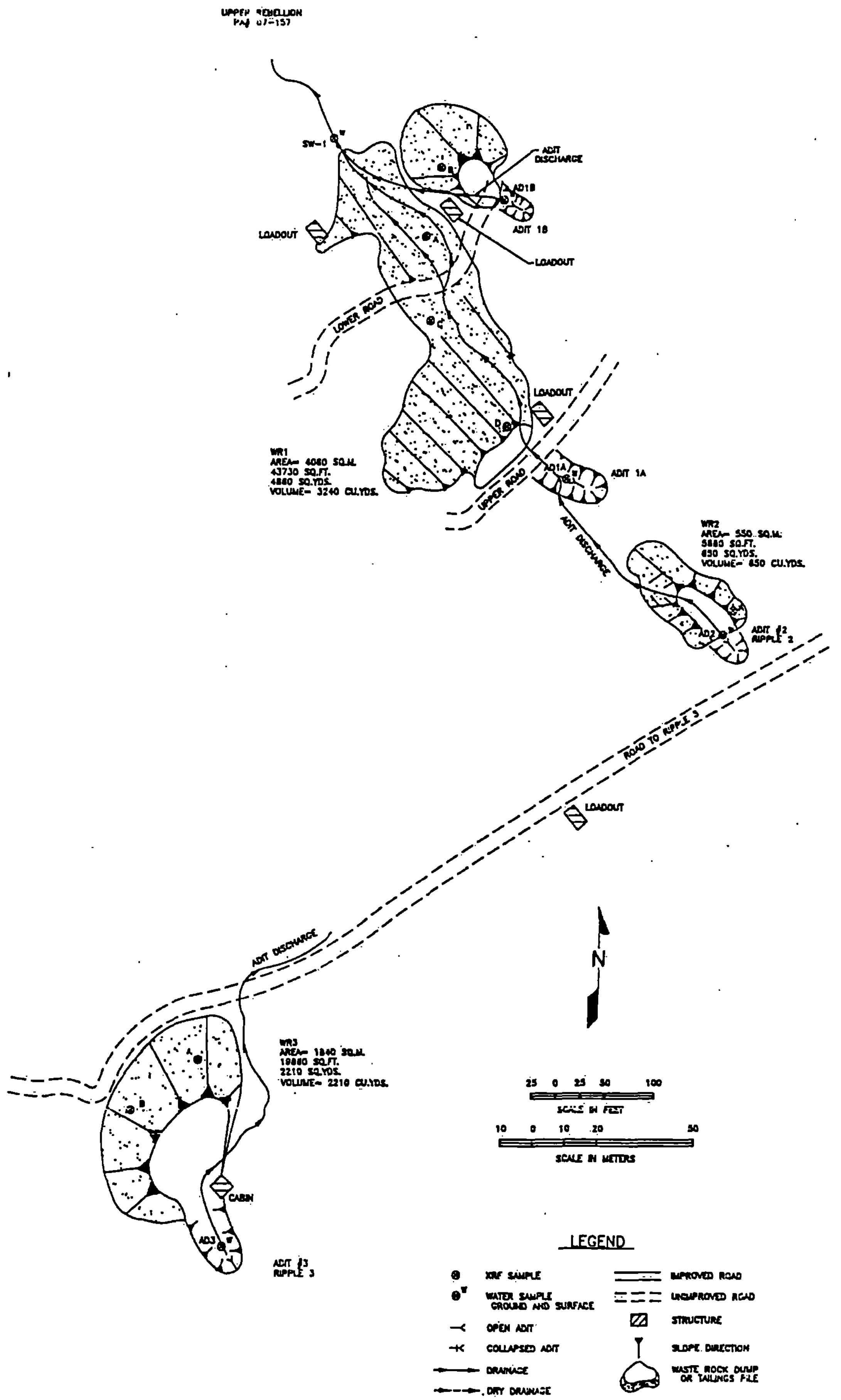
TITLE: FIGURE 1
DETAILED SITE LOCATION MAP
SNOW CREEK MILLSITE PA# 07 505
SOURCE: 1994 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY

DRAWING NO PT340229 REV –
DATE 10/2 /9 PLOT SCALE 1 = 20



DRAWN FOR: PIONEER

TITLE: FIGURE 5
DETAILED SITE LOCATION MAP
LEXINGTON NO. 4 PA# 07-167
SOURCE: 1994 MDSL/AMRB HAZARDOUS



DRAWN FOR:

PIONEER TECHNICAL SERVICES, INC.

TITLE:

FIGURE 6
DETAILED SITE LOCATION MAP
RIPPLE MINES PA# 07-163
SOURCE: 1994 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY

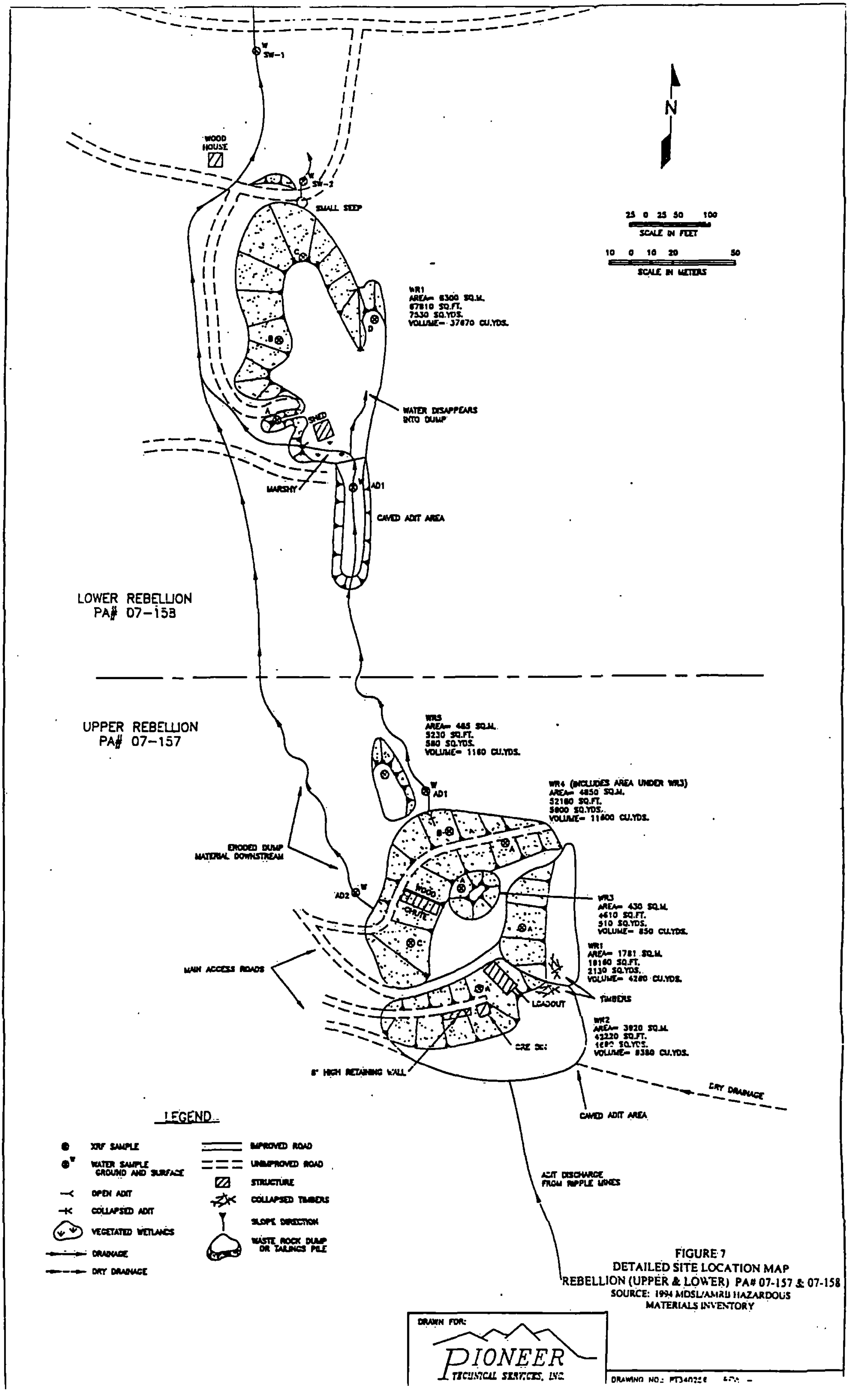
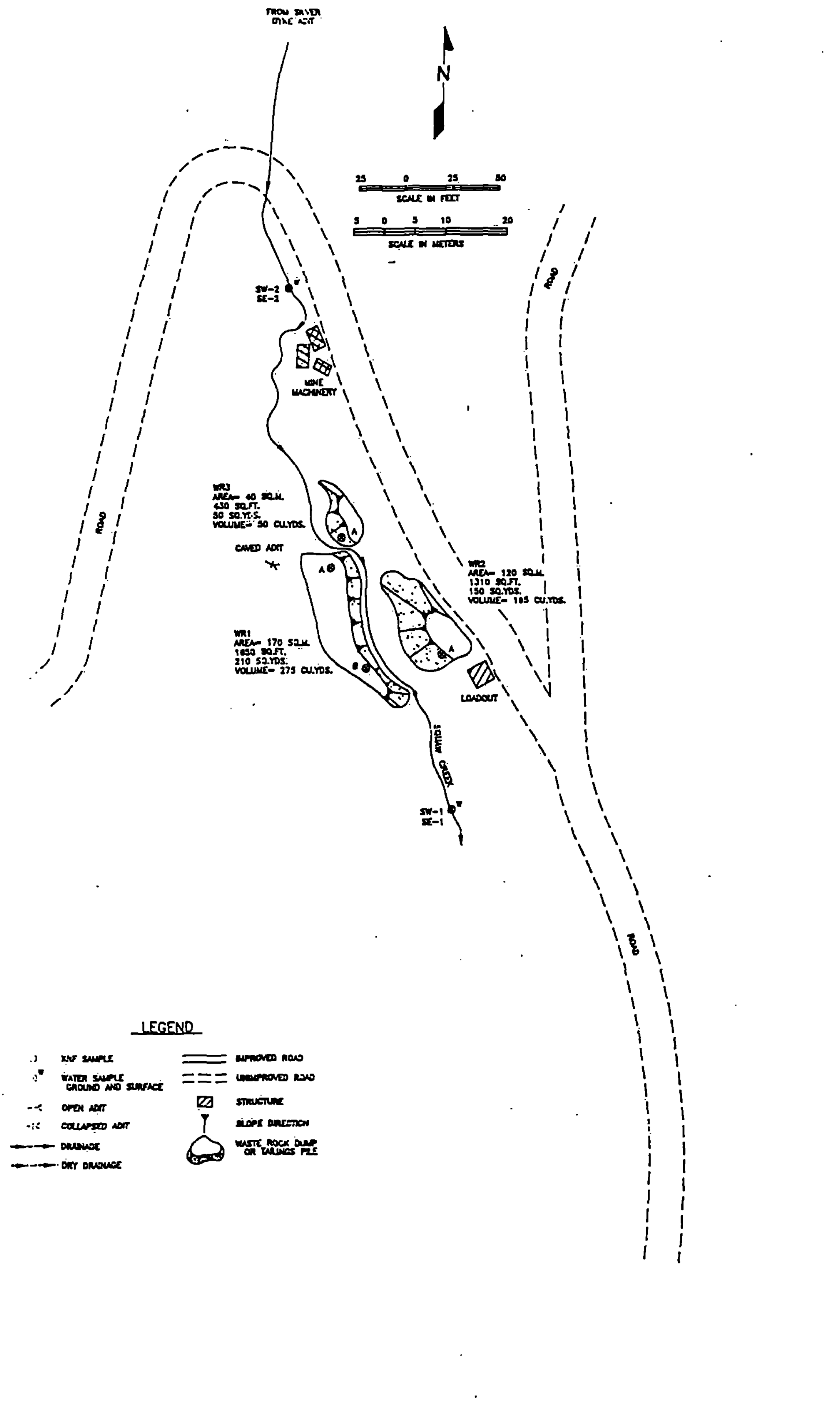


FIGURE 7
DETAILED SITE LOCATION MAP
REBELLION (UPPER & LOWER) PA# 07-157 & 07-158
SOURCE: 1994 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY



DRAWN FOR: PIONEER TECHNICAL SERVICES, INC.	TITLE: FIGURE 8 DETAILED SITE LOCATION MAP EMMA PA# 07-144 SOURCE: 1994 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY
	DRAWING NO.: PT340242 REV: –

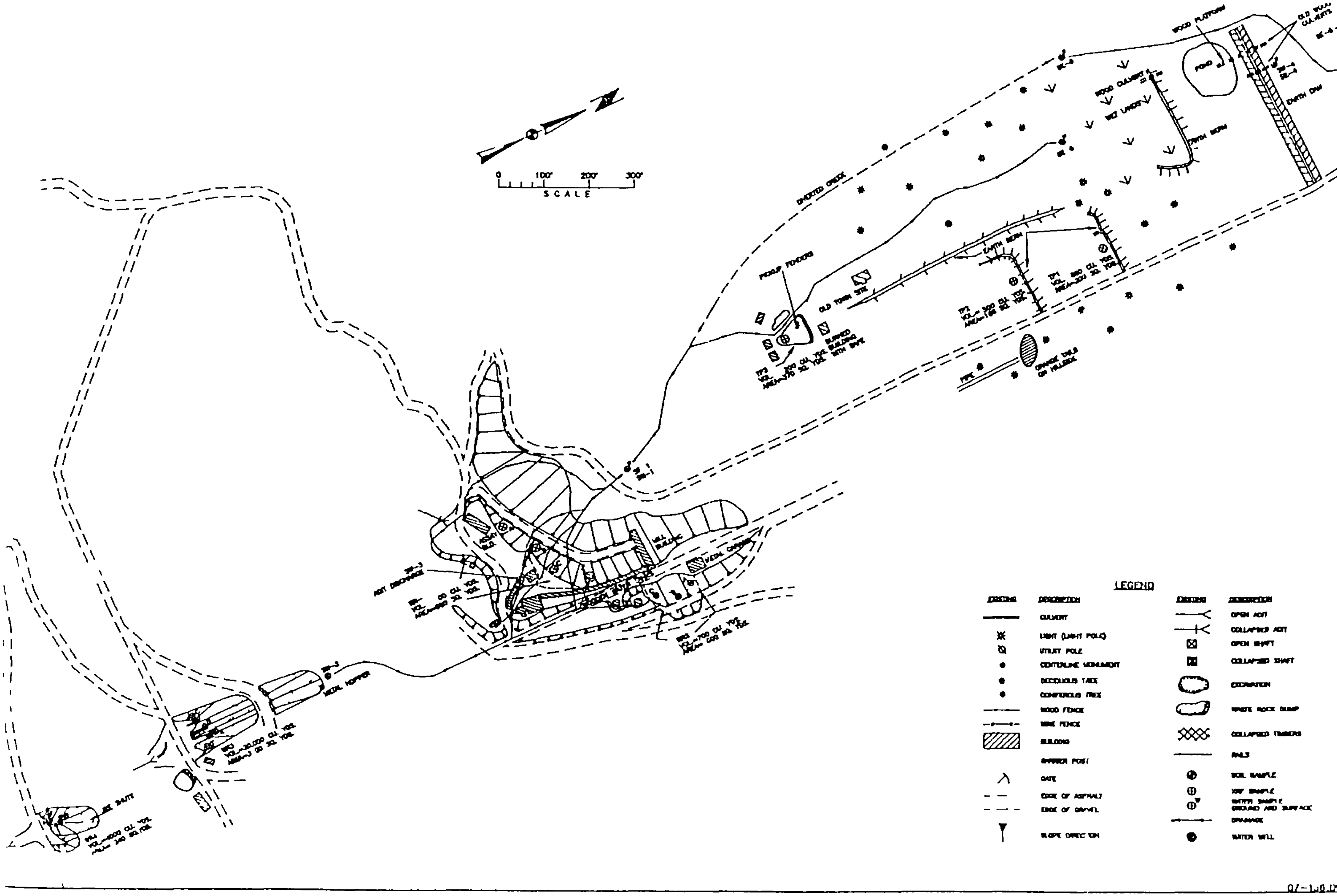


FIGURE 9
DETAILED SITE LOCATION MAP
BIG SEVEN PA# 07 156
SOURCE 1993 MDSL/AMRB HAZARDOUS MATERIALS INVENTORY

PIONEER

THOMAS DEAN & HOSKINS INC
ENGINEERING CONSULTANTS
GREAT FALLS-BOZEMAN-KALISPELL MONTANA

TD&H

SHEET NO

07-156.DWG

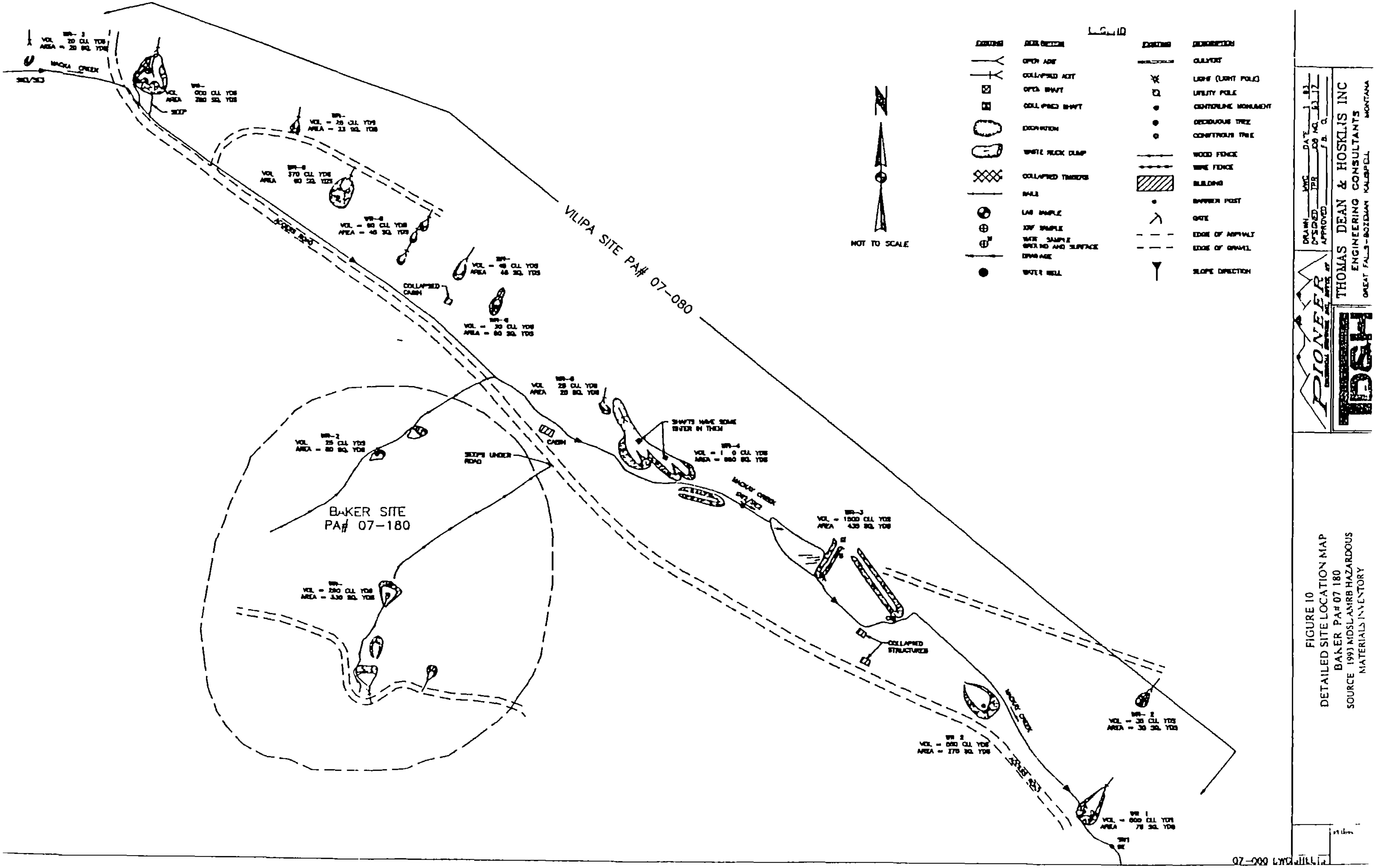


FIGURE 10
DETAILED SITE LOCATION MAP
BAKER PA# 07 180
SOURCE 1993 MDSL AMRB HAZARDOUS MATERIALS INVENTORY

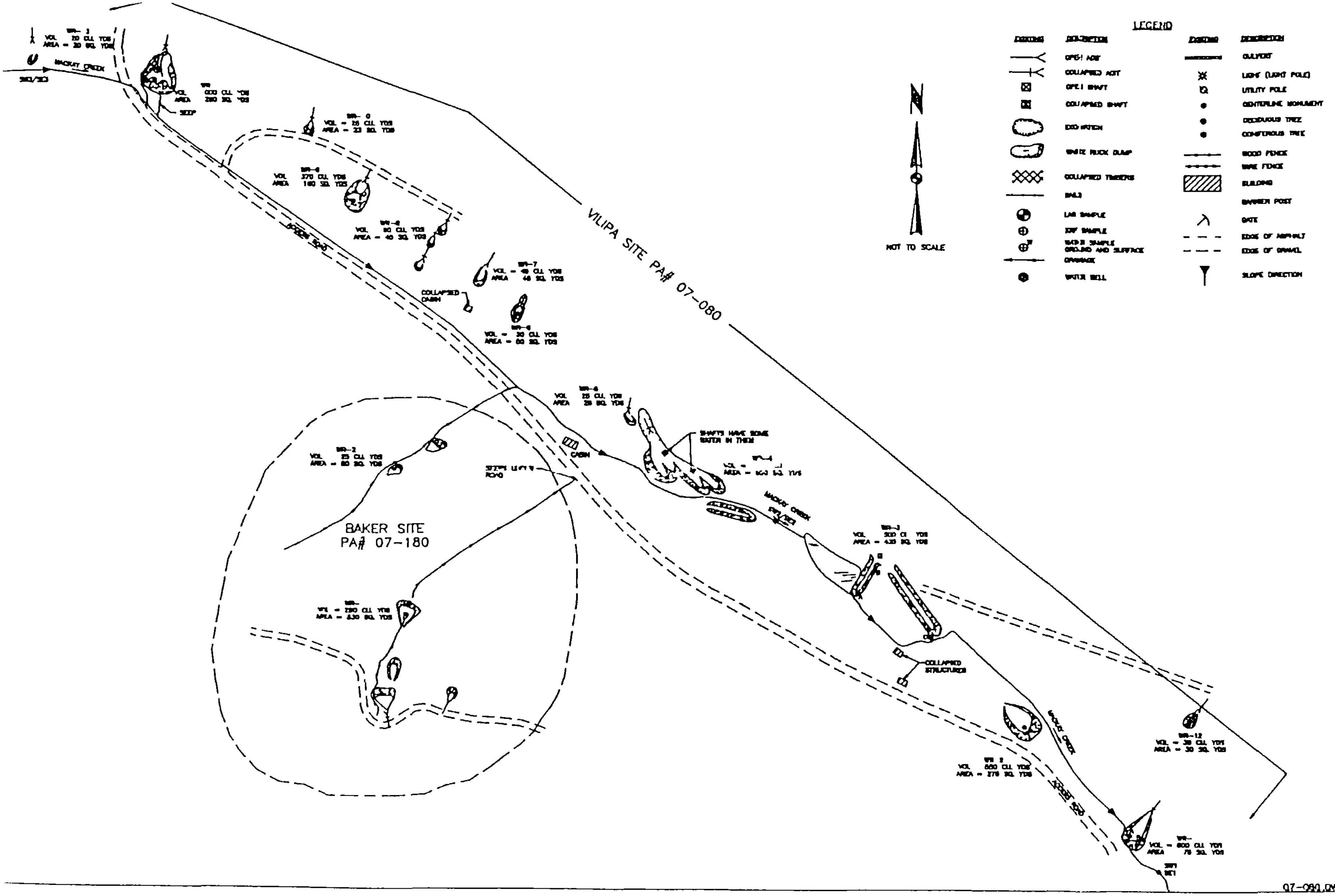


FIGURE 11
DETAILED SITE LOCATION MAP
VILIPA PA# 07-080
SOURCE 1993 MDSL AMRB HAZARDOUS

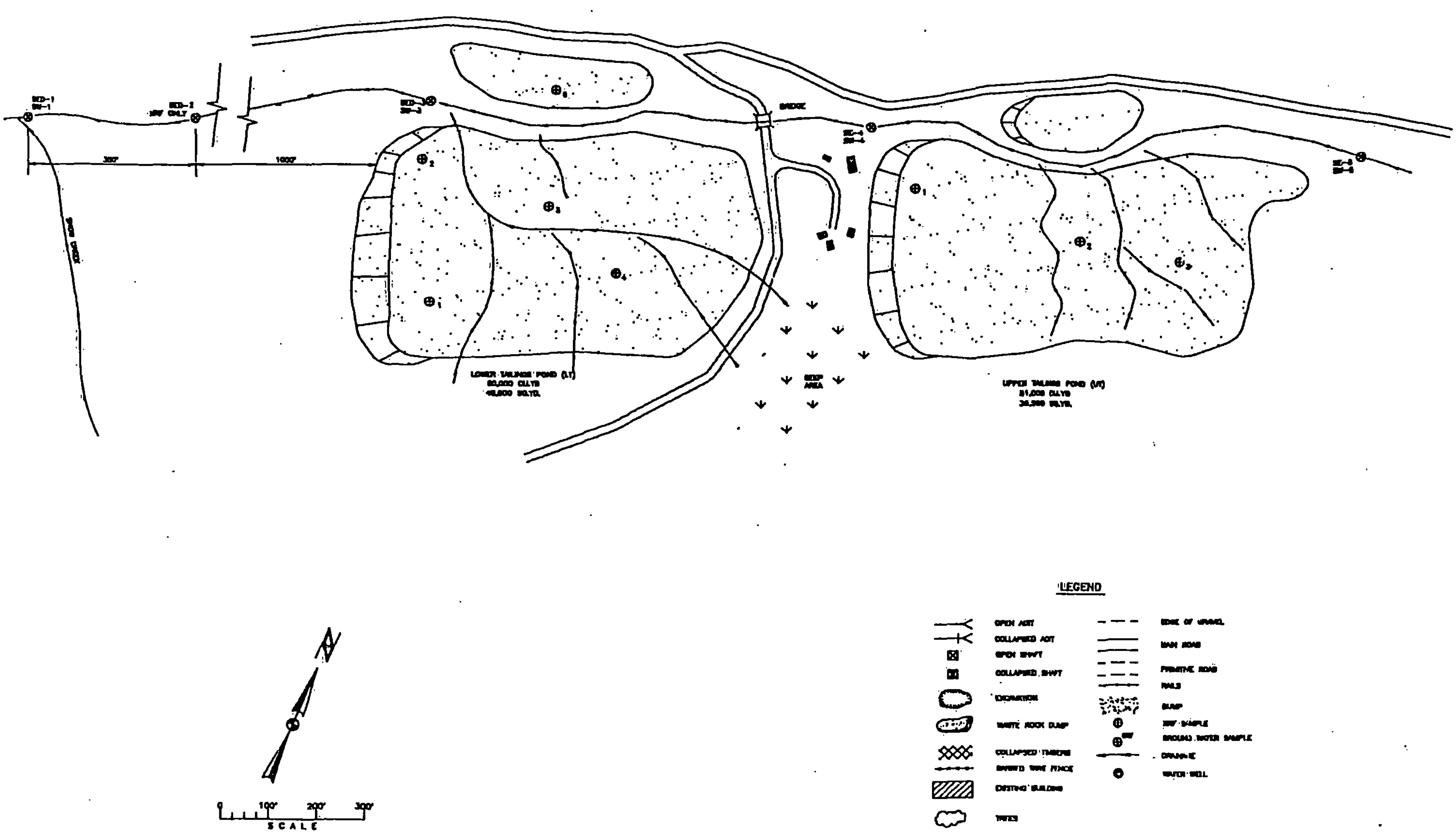


FIGURE 12
DETAILED SITE LOCATION MAP
CARPENTER CREEK TAILINGS PA# 07-103
SOURCE: 1993 MDSL/AMRB HAZARDOUS
MATERIALS INVENTORY

DRAWN JTP DATE 1 JUNE 93
DESIGNED TPR JOB NO. 93-17
APPROVED F.B. NO.

PIONEER

THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS–BOZEMAN–KALISPELL MONTANA
SPOKANE WASHINGTON

SHEET NO.

07-103.DWG SHEETS

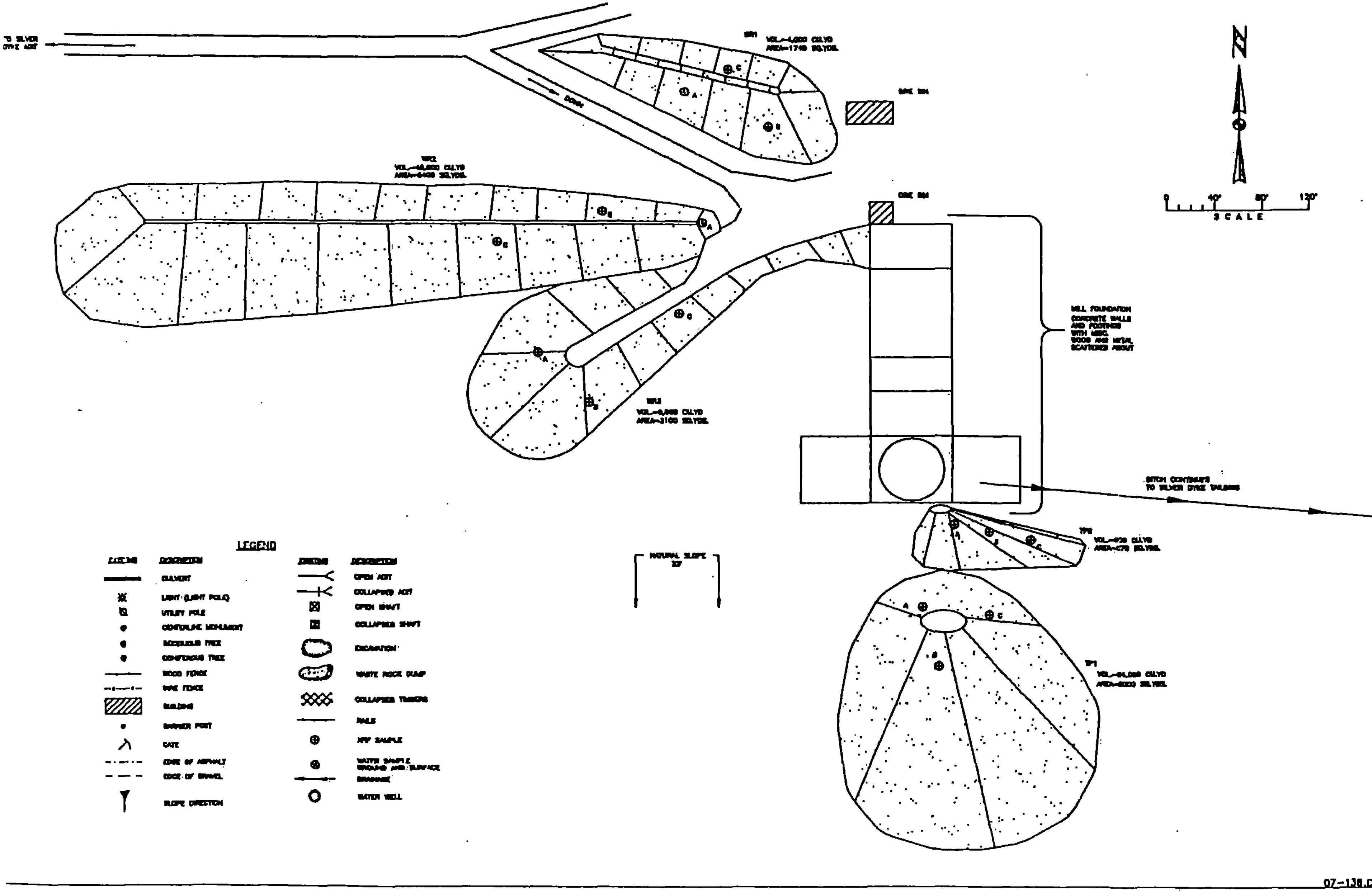


FIGURE 13
DETAILED SITE LOCATION MAP
SILVER DYKE MILLSITE PA# 07-138
SOURCE: 1993 MDSL/AMRB HAZARDOUS
MATERIALS INVENTORY

PIONEER

THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS-BOZEMAN-KALISPELL MONTANA
SPOKANE WASHINGTON

DRAWN JTP DATE 2 JUNE 93
DESIGNED JPR JOB NO. 93-17
APPROVED F.B. NO.

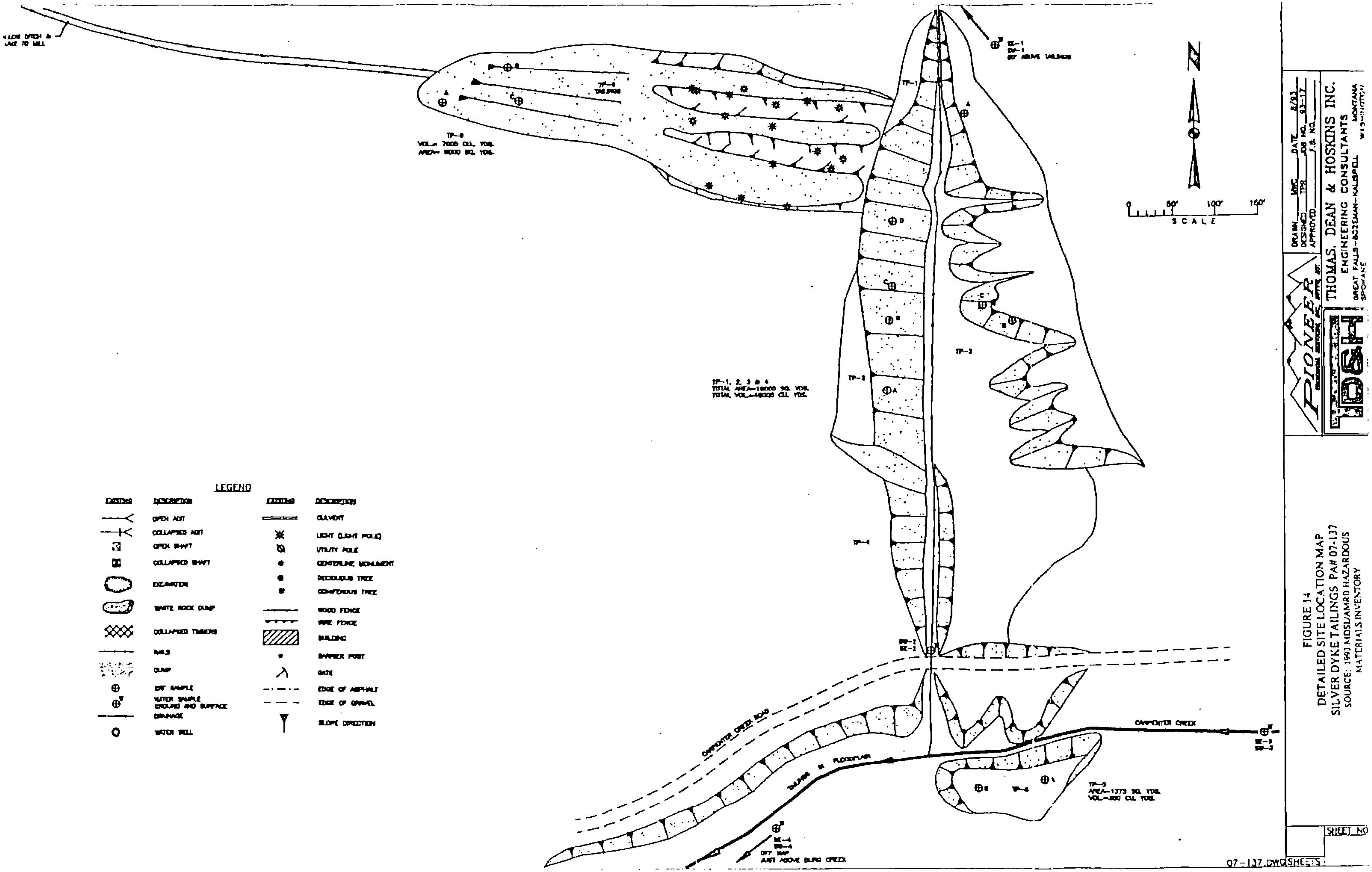
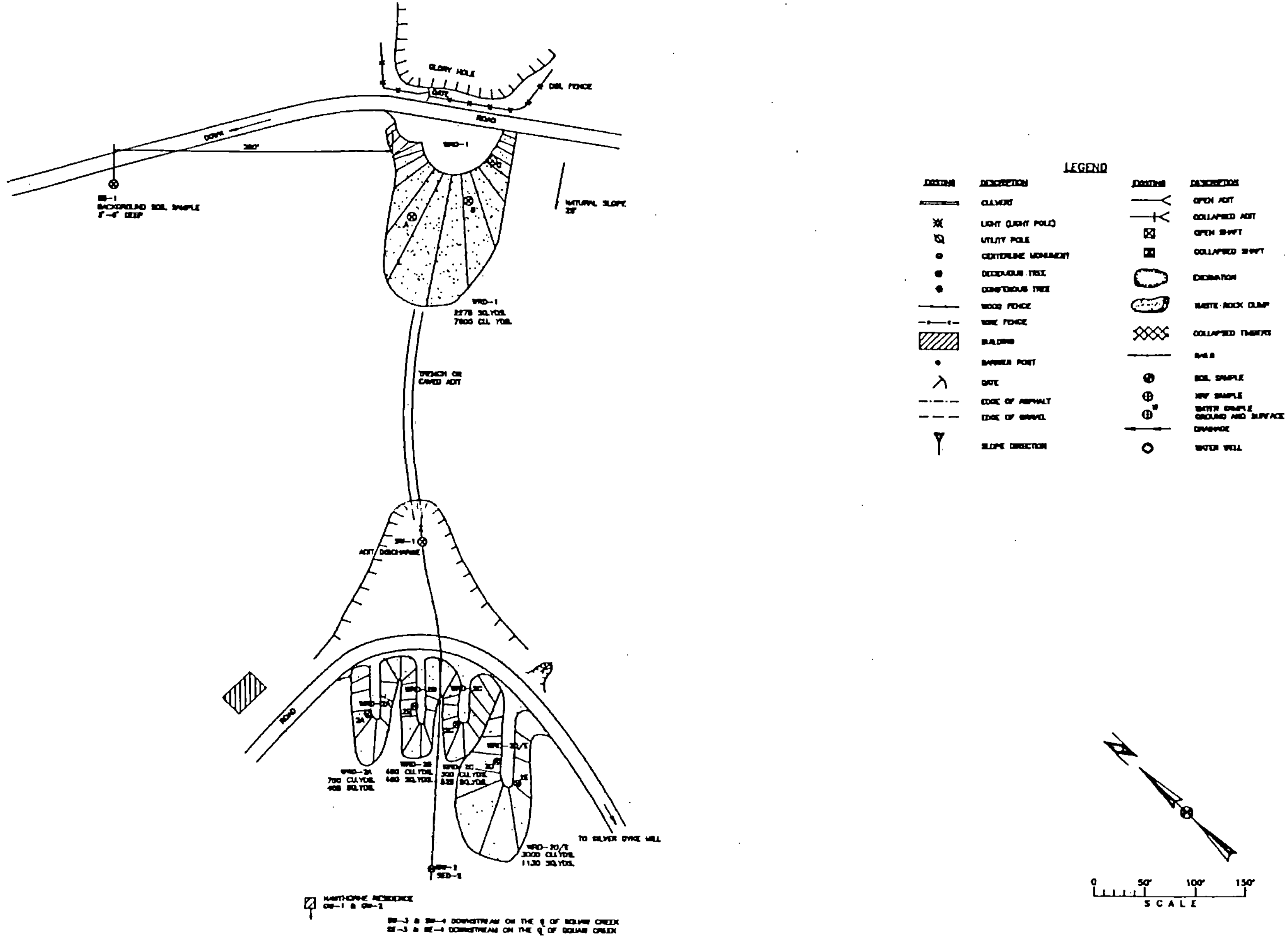


FIGURE 14
DETAILED SITE LOCATION MAP
SILVER DYKE TAILINGS PA# 07-137
SOURCE: 1993 MDSL/AMRB HAZARDOUS
MATERIALS INVENTORY



DRAWN JTP DATE 24 JUNE 93
DESIGNED TPS JOB NO. 93-17
APPROVED F.B. NO.

PIONEER

THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS-BOZEMAN-KALISPELL MONTANA

FIGURE 15
DETAILED SITE LOCATION MAP
SILVER DYKE ADIT PA# 07-135
SOURCE: 1993 MDSL/AMRB HAZARDOUS
MATERIALS INVENTORY

07-135.DWG SHEETS

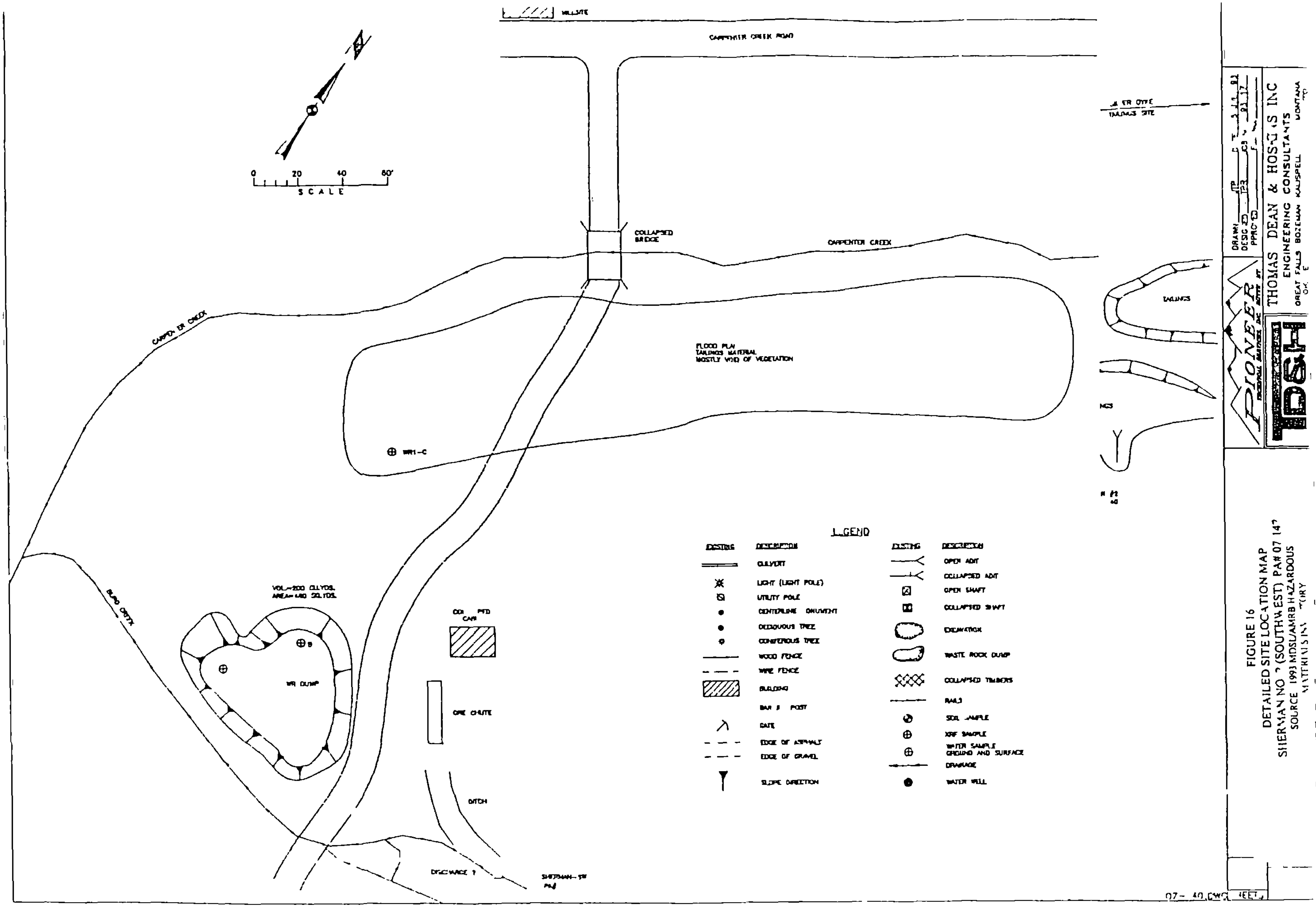
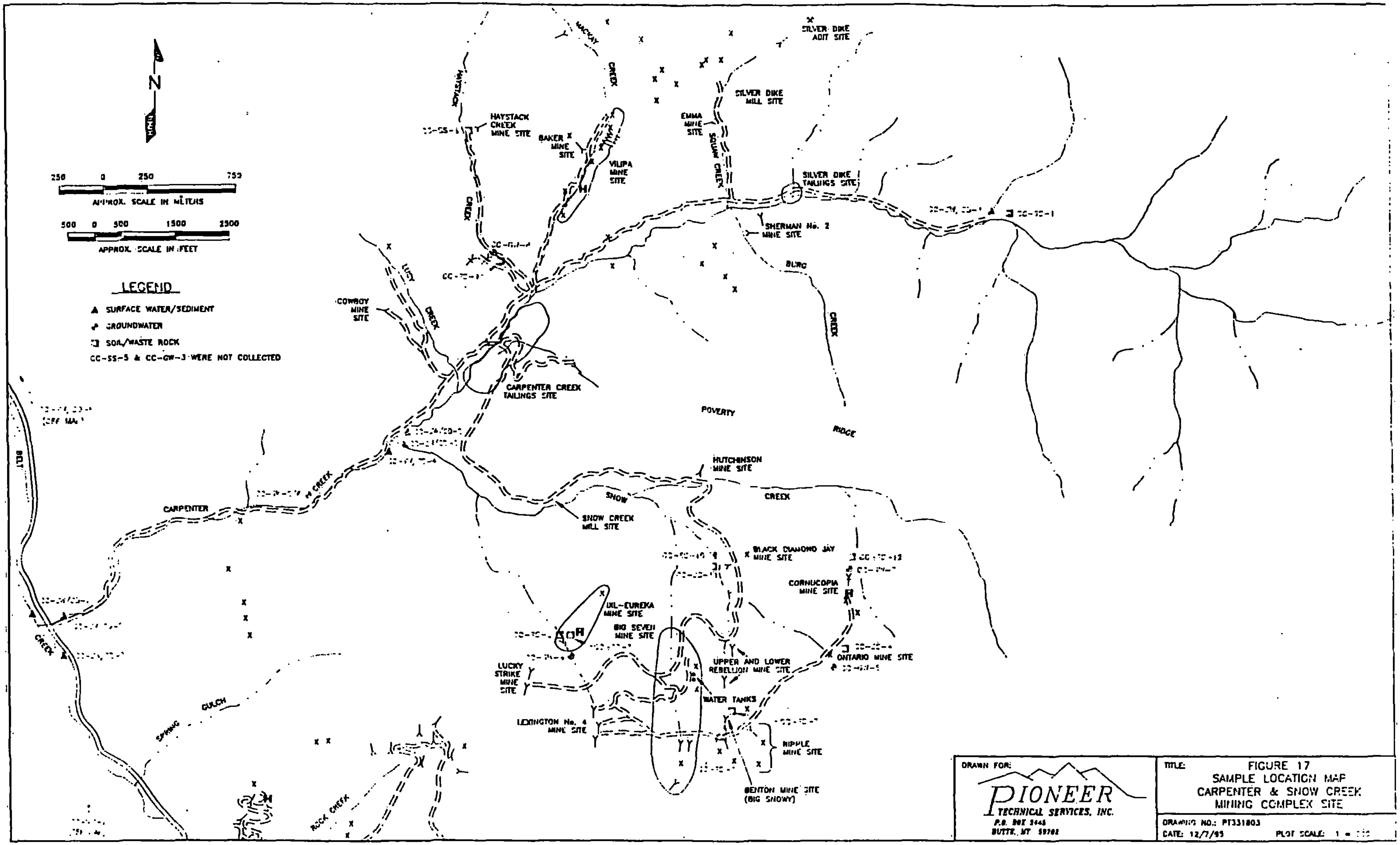
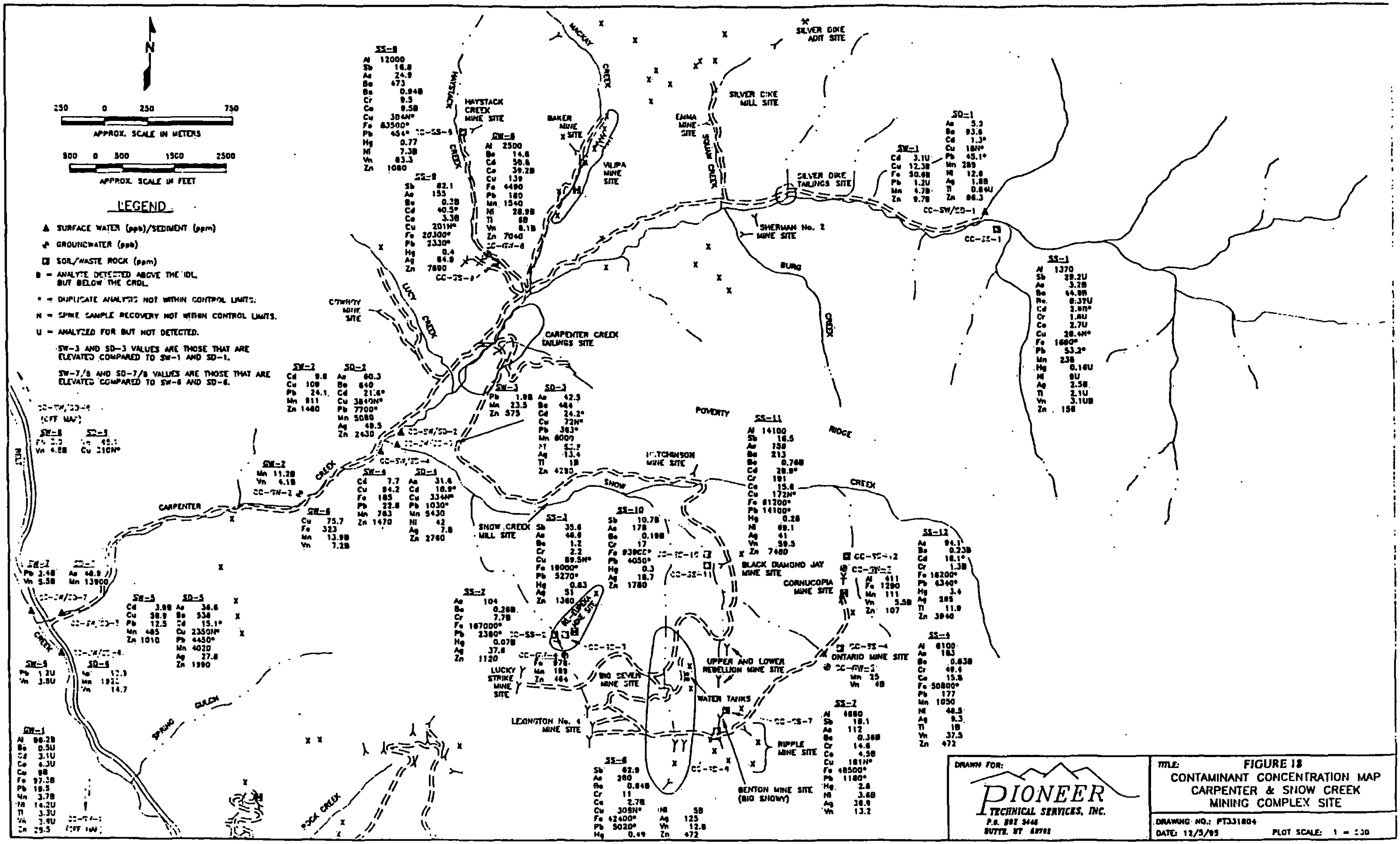


FIGURE 16
DETAILED SITE LOCATION MAP
SHERMAN NO ? (SOUTHWEST) PA# 07 14?
SOURCE 1993 MDSL/AMRB HAZARDOUS
MATERIALS INVENTORY



N
250 0 250 750
APPROX. SCALE IN METERS
500 0 500 1500 2500
APPROX. SCALE IN FEET
LEGEND
SURFACE WATER/SEDIMENT
GROUNDWATER
SOIL/WASTE ROCK
CC-SS-5 & CC-GW-3 WERE NOT COLLECTED
SILVER DIKE ADIT SITE
MACKAY
CREEK
HAYSTACK
HAYSTACK CREEK MINE SITE
BAKER MINE SITE
VILIPA MINE SITE
EMMA MINE SITE
SQUAW CREEK
SILVER DIKE MILL SITE
SILVER DIKE TAILINGS SITE
SHERMAN No. 2 MINE SITE
BURG
CREEK
COWBOY MINE SITE
LUCY
CREEK
CARPENTER CREEK TAILINGS SITE
POVERTY
RIDGE
HUTCHINSON MINE SITE
SNOW
CREEK
SNOW CREEK MILL SITE
CARPENTER
CREEK
BELT
CREEK
BLACK DIAMOND JAY MINE SITE
CORNUCOPIA MINE SITE
UXL-EUREKA MINE SITE
BIG SEVEN MINE SITE
UPPER AND LOWER REBELLION MINE SITE
ONTARIO MINE SITE
LUCKY STRIKE MINE SITE
WATER TANKS
LEXINGTON No. 4 MINE SITE
RIPPLE MINE SITE
BENTON MINE SITE (BIG SNOWY)
SPRING
GULCH
ROCK CREEK
DRAWN FOR:
PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702
TITLE:
FIGURE 17
SAMPLE LOCATION MAP
CARPENTER & SNOW CREEK
MINING COMPLEX SITE
DRAWING NO.: PT331803
DATE: 12/7/95
PLOT SCALE:


N
250 0 250 750
APPROX. SCALE IN METERS
500 0 500 1500 2500
APPROX. SCALE IN FEET
LEGEND
SURFACE WATER (ppb)/SEDIMENT (ppm)
GROUNDWATER (ppb)
SOIL/WASTE ROCK (ppm)
B = ANALYTE DETECTED ABOVE THE IDL, BUT BELOW THE CRDL.
* = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS.
N = SPIKE SAMPLE RECOVERY NOT WITHIN CONTROL LIMITS.
U = ANALYZED FOR BUT NOT DETECTED.
SW-3 AND SD-3 VALUES ARE THOSE THAT ARE ELEVATED COMPARED TO SW-1 AND SD-1.
SW-7/8 AND SD-7/8 VALUES ARE THOSE THAT ARE ELEVATED COMPARED TO SW-6 AND SD-6.
HAYSTACK CREEK MINE SITE
BAKER MINE SITE
VILIPA MINE SITE
EMMA MINE SITE
SILVER DIKE ADIT SITE
SILVER DIKE MILL SITE
SILVER DIKE TAILINGS SITE
SHERMAN No. 2 MINE SITE
COWBOY MINE SITE
CARPENTER CREEK TAILINGS SITE
HUTCHINSON MINE SITE
SNOW CREEK MILL SITE
BLACK DIAMOND JAY MINE SITE
CORNUCOPIA MINE SITE
ONTARIO MINE SITE
UPPER AND LOWER REBELLION MINE SITE
BIG SEVEN MINE SITE
LUCKY STRIKE MINE SITE
LEXINGTON No. 4 MINE SITE
WATER TANKS
RIPPLE MINE SITE
BENTON MINE SITE (BIG SNOWY)
HAYSTACK CREEK
MACKAY CREEK
SQUAW CREEK
BURG CREEK
LUCY CREEK
CARPENTER CREEK
SNOW CREEK
POVERTY RIDGE
SPRING GULCH
ROCK CREEK
BELT
CC-SW/SD-1
CC-SS-1
CC-SW/SD-2
CC-SW/SD-4
CC-GW-2
CC-SW/SD-7
CC-SW/SD-8 (OFF MAP)
CC-GW-1 (OFF MAP)
CC-SS-2
CC-SS-7
CC-SS-9
CC-SS-11
CC-SS-12
CC-SS-4
DRAWN FOR:
PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702
TITLE:
FIGURE 18
CONTAMINANT CONCENTRATION MAP
CARPENTER & SNOW CREEK
MINING COMPLEX SITE
DRAWING NO.: PT331804
DATE: 12/5/95
PLOT SCALE: 1 = 500

TABLES

TABLE 1

DATA SUMMARY FOR THE 1994 MDSL/AMRB SAMPLING

SOLID MATRIX ANALYSES - Metals in soils, Results per dry weight basis (mg/Kg)															
FIELD ID	**Ag**	**As**	**Ba**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Ni**	**Pb**	**Sb**	**Zn**	**Cyanide**
SNOW CREEK MILLSITE															
07 505 SE 1	0 6 UX	21 8 J	187	8 5	11 5	10 6	35 5	15900	0 03 UJ	2700	20 8	142	6 5 UJ	1850	NR
07 505 SE 2	2 0 JX	13 0 J	76 8	6 6	11 4	9 8	31 6	13600	0 03 UJ	2090	19 3	136	6 4 UJ	1540	NR
07 505 TP 1	78 6 JX	25 9 J	7 2	1 3	1 5 U	2 6	61 7	5200	0 24 J	90 7	1 8	962	55 7 J	775	3 552
LEXINGTON NO 4 MINE SITE															
07-167 WR-1	18 9 J	316	37 3	10 8 JX	5 35	7 31 J	46 8 J	36400	0 19	1170 J	8 7	2410 JX	6 8	2850	NR
RIPPLE MINES SITE															
07 163 WR 1	105 J	687	156	8 47 JX	1 8 UJ	1 31	89 3 J	34400	1 12	396 J	5 5	6920 JX	13 5 J	1670	NR
07-163 WR 3	77 J	391	459	2 83 JX	1 4 UJ	1 21	184 J	25300	0 83	163 J	1 32 U	6270 JX	4 9 UJ	515	NR
07-163-SS-1	0 5	9 6	87 6	1 32 JX	9 05 J	27 2 J	10 8 J	21100	0 04	708 J	10 3	52 4 JX	4 7 UJ	135	NR
REBELLION (UPPER & LOWER) MINE SITE															
07 157 WR-1	67 9 J	181	401	10 1 JX	6 37 J	4 86 J	64 0 J	22900	0 48	7090 J	7 6	2380 JX	9 4	2040	NR
07 157 WR 2	98 7 J	155	345	12 8 JX	5 18 J	5 89 J	117 J	36300	0 34	1920 J	5 5	3090 JX	11 4	2950	NR
07-158-WR 1	7 9 J	53 9	29 5	3 71 JX	10 8 J	8 92 J	71 4 J	24000	0 42	1990 J	15 1	713 JX	4 7 UJ	536	NR

TABLE 1 (Cont'd)

DATA SUMMARY FOR THE 1994 MDSL/AMRB SAMPLING

SOLID MATRIX ANALYSES Metals in soils Results per dry weight basis (mg/Kg)															
FIELD ID	**Ag**	**As**	**Ba**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Ni**	**Pb**	**Sb**	**Zn**	**Cyanide**
EMMA MINE SITE															
07 144 SE-1	53 5 J	36 0	67 6	26 0 JX	26 3 J	19 3 J	3510 J	36000	0 03 U	3070 J	9 5	2240 JX	8 9 J	6390	NR
07 144 SE 2	12 3 J	29 5	101	20 7 JX	20 1 J	14 8 J	1050 J	28400	0 04 U	2750 J	8 6	2910 JX	7 6 J	4350	NR
07 144 WR 1	16 2 J	35 9	42 3	52 2 JX	24 4 J	11 4 J	1210 J	47800	0 04	2430 J	14 6	8460 JX	20 2 J	14200	NR

TABLE 1 (Cont'd)

DATA SUMMARY FOR THE 1994 MDSL/AMRB SAMPLING

WATFR MATRIX ANALYSES Metals in water Results in µg/L															
FIELD ID	Ag	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC (mg CaCO3/L)
HUTCHINSON MINE SITE															
07 177 AD 1	0 12 U	1 1 U	6 5	5 0	8 7 U	4 7 UX	30 2	744	0 11 U	139	8 0 U	1 3	29 4 U	108	38 4
SNOW CREEK MILLSITE															
07 505 SW 1	0 12 U	1 9	13 6	4 7	8 7 U	4 7 U	4 6 U	99 9	0 08 U	23 2	8 0 U	1 6	29 4 U	882	64 1
07 505 SW-2	0 12 U	2 2	14 9	2 6 U	8 7 U	4 7 U	4 6 U	77 7	0 08 U	24 9	11 4	1 3	29 4 U	903	65 1
LEXINGTON NO 4 MINE SITE															
07 167 AD 1	0 33	18 5	2 1	9 1	8 7 U	4 7 UX	23 1	2900	0 11 U	1770	8 0 U	96 8	29 4 U	1840	48 4
07 167 SW 1	0 12 U	1 1 U	5 7	5 4	8 7 U	4 7 UX	4 6 U	36 4	0 11 U	234	8 0 U	4 5	29 4 U	1090	37 5

DATA SUMMARY FOR THE 1994 MDSL/AMRB SAMPLING

WATER MATRIX ANALYSES Metals in water Results in μg/L

FIELD ID	Ag	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC (mg CaCO3/L)
RIPPLE MINES SITE															
07 163 AD-1A	0 15	115	22 6	30 6	9 8	4 7 UX	175	15500	0 11 U	5500	17 3	5 4	29 4 U	5530	47 9
07 163 AD 1B	1 00	1 9	7 5	3 1	8 7 U	4 7 UX	36 9	765	0 11 U	431	8 0 U	42 0	29 4 U	505	31 6
07 163 AD 2	0 27	3 1	10 3	2 6 U	8 7 U	11 3 JX	4 6 U	653	0 11 U	29 9	8 0 U	4 0	29 4 U	55 4	21 8
07 163-AD 3	0 89	1 1	31 3	8 0	8 7 U	4 7 UX	73 5	665	0 11 U	1030	8 0 U	50 1	29 4 U	882	23 6
07 163 SW-1	0 35	24 8	15 2	14 3	8 7 U	4 7 UX	103	3530	0 11 U	3180	8 0 U	33 4	29 4 U	3220	39 9
REBELLION (UPPER & LOWER) MINE SITE															
07 157 AD 1	4 42	15 4	15 1	68 5	16 4	7 1 JX	263	6880	0 11 U	10200	45 5	221	29 4 U	10200	113
07 157 AD-2	4 23	12 5	15 0	68 1	16 7	5 5 JX	263	5680	0 11 U	10300	40 8	235	29 4 U	10400	115
07 158 AD-1	1 12	1 1 U	12 2	22 9	11 7	4 7 UX	45 6	1780	0 11 U	9140	29 8	53 5	29 4 U	4730	124
07 158 SW 1	1 13	1 1 U	12 5	42 0	8 7 U	4 7 UX	97 2	25 0	0 11 U	7960	38 9	19 1	29 4 U	7450	116
EMMA MINE SITE															
07 144 SW-1	0 73	1 1 U	20 6	397	96 1	4 7 UX	4370	4220	0 11 U	49900	145	618	112 J	59800	594

TABLE 2

DATA SUMMARY FOR THE 1993 MDSL/AMRB SAMPLING

SOLID MATRIX ANALYSES - Metals in soils Results per dry weight basis (mg/Kg)														
FIFLD ID	**As**	**Ba**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Ni**	**Pb**	**Sb**	**Zn**	**Cyanide**
BIG SEVFN MINE SITE														
07-156 SE 1	242	161	11 1	19 4	13 4	73 2	37800	0 016 U	2870	36 8	518	14 1 J	2900	NR
07 156 SE-4	10 7	175	0 4 U	20 6	138	48	38400	0 016 U	863	67 4	111	5 12 J	312	NR
07-156 SE 5	124	715 J	22 3 J	42 1 J	31 7 J	98 9	39000	0 129	18300	147	887	5 94 UJ	4150	NR
07 156 TP 2	212	365 J	13 5 JX	7 32 J	13 3	55 7	27100	0 071	4140 J	36 J	2510 J	3 03 UJ	2740 J	NR
07 156 TP 3A	121	174	9 5	3 27	18 1	47 2	17900	0 016 U	2710	20 4	434	9 51 J	2430	NR
07 156 TP 3B	126	139	9 7	7 48	30 3	52 1	29700	0 016 U	6860	47 6	576	15 2 J	2530	1 279 U
07 156 WR-1	381	97 2	2 0	14 8	22 8	56 8	55100	0 014 U	1280	17 2	506	5 29 J	785	NR
07 156 WR 2	288	118	1 0	1 4	11	76	33000	0 014 U	146	3 67	2880	9 94 J	631	NR
07-156 WR-3	246	164	0 5 U	1 71	17 6	39 2	32700	0 015 U	71 2	5 1	956	7 02 J	368	NR
07 156 WR-4	265	62 3	10 2	1 22 U	8 97	53 8	30900	0 014 U	47 8	4 96	1220	11 2 J	2200	NR
07-156 SS-1	15 1	166	0 6 U	6 73	25 1	28 3	26600	0 020 U	422	16 5	420	4 33 UJ	336	NR
BAKER MINE SITE														
07 180 WR-1	11	394 J	1 3	1 5 U	1 7	163 J	19000	0 95 J	9 9	2 U	1060 J	14 J	68 J	NR
VILIPA MINE SITE														
07 080 SE-1	8	135 J	6 9	23 4 J	24 4	283 J	19500	0 089 J	1820	14 J	242 J	8 U	650 J	NR
07 080 SE 2	14	188 J	14 6	72 J	14 5	425 J	24300	0 074 J	3840	26 J	899 J	8 U	1170 J	NR
07 080 SE-3	5 U	61 3 J	3 3	8 2 J	23 9	33 8 J	10700	0 03 J	372	12 J	100 J	6 U	315 J	NR
07 080 WR-1	14	137 J	2 1	5 J	17 6	108 J	18100	0 917 J	294	10 J	775 J	7 U	258 J	NR
07 080 WR-2	20	130 J	1 6	6 J	36 9	151 J	22000	0 397 J	217	6 J	530 J	7 U	126 J	NR

TABLE 2 (Cont'd)

DATA SUMMARY FOR THE 1993 MDSL/AMRB SAMPLING

SOLID MATRIX ANALYSES Metals in soils, Results per dry weight basis (mg/Kg)													
FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	Cyanide
CARPENTER CREEK TAILINGS SITE														
07 103 LT-1	61 4	927	24 1	11	14 9 J	3450	42600	0 095 J	4720	31 9	7870	4 21 UJ	2370	1 16 U
07 103 LT 2	25 1	2820	30 6	5 49	9 22 J	2740	28600	0 071 J	3950	24 9	4940	3 59 UJ	2150	1 072 U
07 103 SE 1	73	1100	20 3	12 2	13 7 J	3440	43900	0 071 J	4090	30 7	9540	3 99 UJ	1790	NR
07 103 SE-3	139	905	34 2	21 5	11 5 J	3740	49500	0 062 J	4360	36 8	18500	4 06 UJ	1960	NR
07 103 SE-4	46 6	737	25 0	10 2	15 2 J	2670	38000	0 106 J	5030	34 7	6840	3 88 UJ	2090	NR
07 103 SE-5	34 5	168	12 4	8 72	9 27 J	2910	28000	0 045 J	2100	16 7	5100	3 33 UJ	1090	NR
07 103 UT 1	69 8	663	28 0	11 3	19 2	2850	47500	0 015 U	6830	45 8	4620	5 27 J	2990	1 194 U
07 103 UT 2	36 6	1200	21 3	9 93	16 1	1950	40700	0 019 U	6870	45 4	3750	5 24 J	2050	1 231 U
SILVER DYKE MILL SITE														
07 138 TP-1	69 8	104 J	12 7 JX	13 4 J	12 1	2120	41700	0 023	5050 J	40 9 J	4830 J	3 03 UJ	1510 J	NR
07 138 WR 1	182	289 J	17 3 JX	7 88 J	13	2140	58900	0 366	996 J	13 4 J	8430 J	3 21 UJ	2300 J	NR
07-138 WR 2	111	450 J	40 8 JX	11 6 J	7 57	3730	39200	0 291	3610 J	28 2 J	8220 J	3 17 UJ	4380 J	NR

TABLE 2 (Cont'd)

DATA SUMMARY FOR THE 1993 MDSL/AMRB SAMPLING

WATFR MATRIX ANALYSFS Metals in water, Results in $\mu g/L$													
FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC (mg CaCO3/L)
BIG SEVEN MINE SITE														
07 156-SW-1	1 5 J	8 73	5	6 47	5 7 J	9 17	643	0 3 J	2790 J	38 7	6 17 J	18 3 U	1910 J	82 1
07 156-SW-2	2 38 J	18 3	10 2	5 99 U	5 U	12 2	20 1	0 18 J	590 J	13 6	2 25 J	18 3 U	1230 J	25 3
07 156 SW-3	2 84 J	11 1	13 9	45	5 U	34 8	11400	0 13 J	14500 J	169	8 16 J	18 3 U	6810 J	161
07 156 SW-4	1 55 J	24 7	8 17	5 99 U	5 U	10 5	238	0 21 J	2080 J	83 8	3 33 J	18 3 U	4990 J	243
07 156 SW-5	1 49 U	2 24 U	2 55 U	5 99 U	5 17 J	3 67	13 5 U	0 1 J	4 4 J	8 78 U	1 U	18 3 U	6 U	8 8
VILIPA MINE SITE														
07 080 SW-1	3 22	21 8	2 57 U	9 7 U	6 83 U	18 9	143 J	0 11	24 9	12 7 U	1 8 J	30 7 U	201	36 6
07 080 SW 2	3 51	21 3	2 57 U	9 7 U	6 83 U	20 1	139 J	0 12	23 3	12 7 U	1 5 J	30 7 U	203	34 6
07 080 SW 3	4 05	17 9	2 57 U	9 7 U	6 83 U	4 83	102 J	0 065	4 08 U	12 7 U	1 J	30 7 U	71 8	33 9
CARPENTER CREEK TAILINGS SITE														
07 103 SW-1	2 6	18 6	4 13	5 99 U	8 53 J	62 9 J	174	0 064 J	243	8 78 U	42	18 3 U	560	32 8
07 103 SW 3	2 17	18 3	4 5	5 99 U	5 1 J	62 2 J	226	0 15 J	249	8 78 U	45 8	18 3 U	549	32 9
07-103 SW-4	2 58	14 9	4 4	5 99 U	5 U	54 9 J	127	0 088 J	244	8 78 U	24 8	18 3 U	539	30 2
07-103 SW-5	2 81	15 8	3 37	5 99 U	6 67 J	56 2 J	148	0 083 J	252	9 57	30 4	18 3 U	526	28 4

TABLE 2 (Cont'd)

DATA SUMMARY FOR THE 1993 MDSL/AMRB SAMPLING

SOLID MATRIX ANALYSES - Metals in soils Results per dry weight basis (mg/Kg)														
FIELD ID	**As**	**Ba**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Ni**	**Pb**	**Sb**	**Zn**	**Cyanide**
SILVER DYKE TAILINGS SITE														
07 137 SE 1	17 7	67 3 J	4 4 JX	18 2 J	28 3	63 5	26400	0 023	855 J	26 4 J	586 J	3 1 UJ	712 J	NR
07 137 SE 2	55 9	469 J	13 0 JX	10 5 J	14 3	6440	37300	0 034	2950 J	26 J	7440 J	3 34 UJ	1430 J	NR
07 137 SE 3	14 1	79 1 J	1 5 JX	16 5 J	31 5	55 8	21300	0 023	317 J	23 3 J	145 J	4 43 UJ	237 J	NR
07 137 SE-4	70 9	724 J	14 7 JX	12 8 J	45 2	3680	45500	0 073	2670 J	48 6 J	7730 J	4 36 UJ	1670 J	NR
07 137 TP-1	48 1	836 J	8 1 JX	4 15 J	11 9	4200	36600	0 057	1080 J	12 1 J	8620 J	2 96 UJ	816 J	NR
07 137 TP-2	64 5	1040 J	6 7 JX	7 49 J	20 7	5510	45000	0 066	2120 J	17 1 J	14200 J	3 51 UJ	798 J	NR
07 137 TP-6	54 2	254 J	6 7 JX	8 55 J	12 5	1140	31300	0 051	1560 J	16 J	2920 J	3 01 UJ	838 J	NR
SILVER DYKE ADIT SITE														
07 135 SE 2	105	164	50 4	11 2	10 3	1500	36500	0 28	1680	13 8	15000	4 05 UJ	6580	NR
07 135-SE-3	33 9	70 7	5 4	11 2	17 5	933	23700	0 062	2230	17	2460	3 07 UJ	842	NR
07 135 SE-4	31 4	49 5	9 5	14 6	14 2	875	24200	0 062 U	1920	14 9	1960	3 22 UJ	1330	NR
07 135 WR-1	124	198	72 7	6 9	10 6	3330	60300	1 35	1460	12 3	31800	5 8 J	7050	NR
07 135 WR-2	217	237	48 6	19	11 2	2530	80900	0 66	4040	29 6	16400	2 8 UJ	6050	NR
07 135-SS 1	10 5	131	1 4	6 83	22 2	26 1	20600	0 048 U	607	15 6	667	3 39 UJ	548	NR

TABLE 2 (Cont'd)

DATA SUMMARY FOR THE 1993 MDSL/AMRB SAMPLING

WATER MATRIX ANALYSFS - Metals in water Results in $\mu g/L$														
FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC (mg CaCO3/L)
SILVER DYKE TAILINGS SITE														
07 137 SW 1	1 49 U	9 4	2 55 U	5 99 U	9 03 J	1 35 U	20 1	0 15 J	2 6 U	8 78 U	1 U	18 3 U	20 J	26 8
07 137 SW 2	1 49 U	24 2	2 55 U	5 99 U	12 5 J	24 2	85 4	0 17 J	15 8 J	8 78 U	32 2 J	18 3 U	80 5 J	36 5
07 137 SW 3	1 49 U	10 2	2 55 U	5 99 U	12 3 J	1 35 U	45 2	0 29 J	2 6 U	8 78 U	1 2 J	18 3 U	6 U	23 1
07 137 SW-4	1 49 U	11 4	2 55 U	5 99 U	6 43 J	3 8	62 8	0 15 J	4 37 J	8 78 U	8 36 J	18 3 U	9 9 J	23 7
SILVER DYKF ADIT SITE														
07 135 GW 1	2 5	29 3	2 55 U	5 99 U	5 U	12 3	173 J	0 150	75 9 JX	8 78 U	5 24 J	18 3 U	497	83 1
07 135 GW 2	2 84	29 4	2 55 U	5 99 U	5 U	25 3	308 J	0 079	204 JX	8 78 U	4 76 J	18 3 U	1350	83 6
07 135 SW-1	4 88	2 24 U	986 J	260	22 7	8950	37400 J	0 150	128000 JX	878	826 J	194	148000	1320
07 135 SW 2	7 12	10 6	838 J	208	18	9440	21900 J	0 120	109000 JX	738	1400 J	147	120000	1090
07 135 SW 3	4 37	16 2	339 J	69	5 U	4220	1540 J	0 140	43100 JX	310	568 J	40 6	56900	495
07-135 SW-4	4 79	21 5	223 J	46	5 U	2700	1290 J	0 160	26000 JX	201	343 J	37	36800	381

U Not Dctected J - Estimated Quantity X Outlier for Accuracy or Precision NR - Not Requested

TABLE 3 DATA SUMMARY FOR THE 1990 MDEQ/AMRB SURFACE WATER SAMPLING (PPB)

Location	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
Snow Ck prior to Carpenter Ck	<1	2 3	<20	40	<1	980
Carpenter Ck upstrm of upper Carpenter Ck tailings pond	<1	6 8*	<20	<40	5	1,080
Carpenter Ck dwnstrm of lower Carpenter Ck tailings pond	<100	<5	20	<30	<70	840
Carpenter Ck upstrm of Silver Dyke Tailings Site	<1	< 1	<20	<40	<1	<10
Silver Dyke Adit Site adit discharge	<1	596*	4,550#	32,000	345+	329,000

*Exceeds the MCL for cadmium of 5 ppb
#Exceeds the action level for copper of 1,300 ppb
+Exceeds the action level for lead of 15 ppb

TABLE 4 DATA SUMMARY FOR THE 1990 MDEQ/AMRB SOURCE SAMPLING (PPM)

Location	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
Carpenter Ck Tailings Site upper tailings pond	164	23	1670	49700	4740	2810
Silver Dyke Tailings Site at failed dam	265	2	4470	40900	13100	675
Silver Dyke Tailings Site above failed dam	184	14	2140	41000	5140	1450
Silver Dyke Tailings Site large dump below and west of mine	166	22	1910	44600	5160	2580
Silver Dyke Tailings Site at Carpenter Ck	263	31	4310	41700	12500	1020
Silver Dyke Adit Site dump	164	8	1020	27100	4840	530
Silver Dyke Adit Site dump	242	2	2850	44600	9320	1510
Silver Dyke Adit Site shear zone east of adit	92	12	138	57600	3240	2800

TABLE 5

SURFACE WATER AND QA/QC SAMPLE SUMMARY
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

SAMPLE NUMBER	TYPE	LOCATION	ANALYSES	RATIONALE
CC-SW-1	Grab	Upstream Carpenter Ck	TM	Assess upstream conditions
CC-SW-2	Grab	Carpenter Ck just prior to confluence with Snow Ck	TM	Assess target impact
CC-SW-3	Grab	Snow Ck just prior to confluence with Carpenter Ck	TM	Assess conditions
CC-SW-4	Grab	Carpenter Ck just below confluence with Snow Ck (PPE)	TM	Assess conditions - PPE
CC-SW-5	Grab	Carpenter Ck just prior to confluence with Belt Ck	TM	Assess target impact
CC-SW-6	Grab	Belt Ck just upstream of confluence with Carpenter Ck	TM	Assess upstream conditions
CC-SW-7	Grab	Belt Ck downstream of confluence with Carpenter Ck	TM	Assess target impact
CC-SW-8	Grab	Belt Ck prior to Monarch	TM	Assess target impact
CC-SW-9	QA/QC	Soil equipment rinsate	TM	QA/QC for deco
CC-SW-10	QA/QC	Bottle blank	TM	QA/QC for bottl. quality

TM - Total Metals
PPE - Probable Point of Entry to surface water
QA/QC - Quality assurance/quality control

TABLE 6

SEDIMENT SAMPLE SUMMARY
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

SAMPLE NUMBER	DEPTH	TYPE	LOCATION	ANALYSES	RATIONAL
CC-SD-1	0-2"	Grab	Upstream Carpenter Ck	TM	Assess background conditions
CC-SD-2	0-2"	Grab	Carpenter Ck just prior to confluence with Snow Ck	TM	Assess condit at PPE
CC-SD-3	0-2"	Grab	Snow Ck just prior to confluence with Carpenter Ck	TM	Assess condit
CC-SD-4	0-2"	Grab	Carpenter Ck just below confluence with Snow Ck (PPE)	TM	Assess condit at PPE
CC-SD-5	0-2"	Grab	Carpenter Ck just prior to confluence with Belt Ck	TM	Assess target impact
CC-SD-6	0-2"	Grab	Belt Ck just upstream of confluence with Carpenter Ck	TM	Assess upstre conditions
CC-SD-7	0-2"	Grab	Belt Ck downstream of confluence with Carpenter Ck	TM	Assess target impact
CC-SD-8	0-2"	Grab	Belt Ck prior to Monarch	TM	Assess target impact

TM - Total Metals
PPE - Probable Point of Entry to surface water

TABLE 7

GROUNDWATER SAMPLE SUMMARY
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

SAMPLE NUMBER	TYPE	LOCATION	ANALYSIS	RATIONALE
CC-GW-1	Grab	Upgradient groundwater (Neihart)	TM	Assess background conditions
CC-GW-2	Grab	Downgradient groundwater (Carpenter Ck Rd)	TM	Assess release to groundwater
CC-GW-4	Grab	IXL-Eureka adit discharge	TM	Assess groundwater
CC-GW-5	Grab	Ontario adit discharge	TM	Assess groundwater
CC-GW-6	Grab	Duplicate of CC-GW-2	TM	Assess reproducibility
CC-GW-7	Grab	Cornucopia adit discharge	TM	Assess groundwater
CC-GW-8	Grab	Haystack Ck adit discharge	TM	Assess groundwater

TM - Total Metals

TABLE 8

SOIL SAMPLE SUMMARY
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

SAMPLE NUMBER	MEDIA/ DEPTH	TYPE	LOCATION	ANALYSIS	RATIONALE
CC-SS-1	Soil/0-6"	Comp	Background	TM	Assess backgr soil
CC-SS-2	WR/0-6"	Comp	IXL-Eureka	TM	Characterize s
CC-SS-3	WR/0-6"	Comp	IXL-Eureka	TM	Characterize source
CC-SS-4	WR/0-6"	Comp	Ontario	TM	Characterize s
CC-SS-6	WR/0-6"	Comp	Benton (Big Snowy)	TM	Characterize s
CC-SS-7	WR/0-6"	Comp	Benton (Big Snowy)	TM	Characterize s
CC-SS-8	WR/0-6"	Comp	Haystack Ck	TM	Characterize s
CC-SS-9	WR/0-6"	Comp	Unnamed mine on Haystack Ck	TM	Characterize s
CC-SS-10	WR/0-6"	Comp	Black Diamond Jay	TM	Characterize s
CC-SS-11	WR/0-6"	Comp	Black Diamond Jay	TM	Characterize s
CC-SS-12	WR/0-6"	Comp	Cornucopia	TM	Characterize s

TM - Total Metals
Comp - Composite
WR - Waste Rock

TABLE 9

SURFACE WATER AND GROUNDWATER FIELD PARAMETERS
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

SAMPLE NUMBER	pH (S U)	SC (umhos/cm)	TEMPERATURE (C)	ESTIMATED FLOW
CC-SW-1	8 84	64	11 7	7 5 (avg) cfs Carpenter Ck
CC-SW-2	8 64	149 3	17 6	7 5 (avg) cfs Carpenter Ck
CC-SW-3	9 10	135 6	13 4	1 5 (avg) cfs Snow Ck
CC-SW-4	8 53	144 9	16 7	7 5 (avg) cfs Carpenter Ck
CC-SW-5	8 40	173 5	16 3	7 5 (avg) cfs Carpenter Ck
CC-SW-6	8 59	158 3	14 6	125 (avg) cfs Belt Ck
CC-SW-7	8 20	185 2	16 0	125 (avg) cfs Belt Ck
CC-SW-8	6 57	150 3	12 6	125 (avg) cfs Belt Ck
CC-GW-1	8 91	19	9 0	20 gpm
CC-GW-2	8 10	219	8 7	NA
CC-GW-4	7 29	207	6 8	6 gpm
CC-GW-5	7 66	52	3 9	8 gpm
CC-GW-7	7 99	158	7 0	10 gpm
CC-GW-8	3 8	6 10	8 8	5 gpm

S U - Standard units
cfs - Cubic feet per second
gpm - Gallons per minute
SC - Specific conductance

TABLE 10

SURFACE WATER AND QA/QC TOTAL METALS SAMPLING RESULTS (PPB)
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

Analyte	CC-SW-1 Upstm CC	CC-SW-2 CC prior to Snow Ck	CC SW 3 Snow Ck prior to CC	CC SW-4 CC PPE	CC-SW-5 CC prior to Belt Ck	CC SW-6 Belt Ck upstm of CC	CC-SW-7 Belt Ck dwnstm of CC	CC-SW 8 Belt Ck prior to Monarch	CC SW 9 Soil eqp rinsate	CC SW 10 Bottle Blank
Aluminum	32 6B	91 3B	57 4B	86 5B	44 8B	74 0B	72 5B	130B	30 1B	32 9B
Antimony	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U
Arsenic	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U
Barium	16 1B	31 0B	14 8B	32 5B	27 5B	103B	89 0B	106B	3 6UB	3 1UB
Beryllium	0 50U	0 50U	0 50U	0 50U	0 50U	0 50U	0 50U	0 50U	0 54B	0 50U
Cadmium	3 1U	9 8	3 1U	7 7	3 9B	3 1U	3 1U	3 1U	3 1U	3 1U
Chromium	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U
Cobalt	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U
Copper	12 3B	109	8 3B	94 2	58 9	7 5B	15 3B	14 2B	7 8B	7 7B
Iron	50 6B	151	116	185	101	94 7	98 2B	154	44 2B	42 2B
Lead	1 2U	24 1	1 9B	22 8	12 5	1 2U	2 4B	3 0	1 2U	1 2U
Manganese	4 7B	911	23 5	763	485	44 5	108	48 8	3 5B	3 5B
Mercury	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U
Nickel	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U
Selenium	2 9U	2 9U	2 9U	2 9U	2 9U	2 9U	2 9U	2 9U	3 9B	2 9U
Silver	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U
Thallium	3 3U	3 3U	3 3U	3 3U	3 3U	3 3U	3 3U	3 3U	4 5B	3 3U
Vanadium	3 8U	3 8U	3 8U	3 8U	3 8U	3 8U	5 5B	4 8B	3 8U	3 8U
Zinc	9 7B	1480	575	1470	1010	75 0	215	127	9 4B	11 9B

PPE - Probable Point of Entry
CC - Carpenter Creek
U - The material was analyzed for, but was not detected above the level of the associated value The associated value is either the sample quantitation limit or the sample detection limit
B - The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL)

TABLE 11

SEDIMENT TOTAL METALS SAMPLING RESULTS (PPM)
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

Analyte	CC-SD-1 Upstm CC	CC-SD 2 CC prior to Snow Ck	CC-SD 3 Snow Ck prior to CC	CC SD-4 CC PPE	CC-SD 5 CC prior to Belt Ck	CC-SD 6 Belt Ck upstm of CC	CC-SD 7 Belt Ck dwnstm of CC	CC-SD 8 Belt Ck prior to Monarch
Aluminum	10900	4910	11200	9450	6110	7100	6960	6890
Antimony	11 7U	12 9U	14 5U	11 8U	11 7U	11 7U	12 8U	13 4U
Arsenic	5 9	60 3	42 5	31 6	36 6	12 9	48 9	24 6
Barium	93 6	640	484	150	538	963	1950	567
Beryllium	0 72B	0 95B	2 0U	1 9U	1 3U	0 64B	0 64B	0 86B
Cadmium	1 3*	21 6*	24 2*	18 9*	15 1*	4 3*	7 3*	6 3*
Chromium	29 5	18 5	30 2	21 8	37 2	16 1	17 1	28 4
Cobalt	11 9B	14 3	21 4	22 6	17 5	84 8	10 5B	10 3B
Copper	18 0N*	3840N*	72 0N*	334N*	2350N*	28 3N*	34 0N*	310N*
Iron	27300*	48000*	30100*	30800*	56800*	26600*	34800*	28700*
Lead	45 1*	7700*	363*	1030*	4450*	507*	969*	782*
Manganese	289	5080	6000	5430	4020	1920	13900	2000
Mercury	0 06U	0 07U	0 08U	0 06U	0 06U	0 06U	0 07U	0 07U
Nickel	12 6	13 9	53 8	42 0	15 0	17 8	23 7	19 6
Selenium	0 87B	0 82U	0 92U	0 74U	0 74U	0 74U	0 81U	0 85U
Silver	1 8B	49 5	13 4	7 8	27 8	5 9	17 4	9 5
Thallium	0 84U	0 93U	1 0B	0 85U	0 84U	0 91B	1 6B	0 96U
Vanadium	84 5	0 93U	32 8	57 4	160	14 7	14 7	65 1
Zinc	96 3	2430	4280	2760	1990	774	1570	1100

CC - Carpenter Creek

U - The material was analyzed for, but was not detected above the level of the associated value The associated value is either the sample quantitation limit or the sample detection limit

N - Spike sample recovery not within control limits

B - The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL)

* Duplicate analysis not within control limits

TABLE 12

GROUNDWATER TOTAL METALS SAMPLING RESULTS (PPB)
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

Analyte	CC GW-1 Upgrdt	CC GW-2 Dwgrdt	CC GW-4 IXL adit	CC-GW-5 Ontario adit	CC GW-6 Dup of GW 2	CC GW-7 Cornucopia adit	CC-GW 8 Haystack Ck adit
Aluminum	96 2B	32 7B	142B	55 3B	24 6U	411	2500
Antimony	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U	45 9U
Arsenic	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U	2 3U
Barium	69 2B	28 9B	6 6B	8 1B	23 3B	12 0B	21 0B
Beryllium	0 50U	0 50U	0 50U	0 50U	0 50U	0 50U	14 6
Cadmium	3 1U	3 1U	3 1U	3 1U	3 1U	3 1U	50 6
Chromium	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U	2 8U
Cobalt	4 3U	4 3U	4 3U	4 3U	4 3U	4 3U	39 2B
Copper	9 0B	24 8B	12 1B	8 7B	75 7	16 4B	139
Iron	97 3B	283	978	109	323	1290	4490
Lead	19 5	2 3B	2 6B	1 2U	3 4	11 7	180
Manganese	3 7B	11 2B	189	25 0	13 9B	111	1540
Mercury	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U	0 10U
Nickel	14 2U	14 2U	14 2U	14 2U	14 2U	14 2U	28 9B
Selenium	2 9U	2 9U	2 9U	2 9U	2 9U	2 9U	2 9U
Silver	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U	2 2U
Thallium	3 3U	3 3U	3 3U	3 3U	3 3U	3 3U	6 0B
Vanadium	3 8U	4 1B	3 8U	4 0B	7 2B	5 5B	8 1B
Zinc	28 5	70 0	464	9 1B	80 3	107	7040

CC - Carpenter Creek

U - The material was analyzed for but was not detected above the level of the associated value The associated value is either the sample quantitation limit or the sample detection limit

B - The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL)

TABLE 1[illegible]

SOIL TOTAL METALS SAMPLING RESULTS (PPM)
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

Analyte	CC SS-1 Bkgd	CC-SS 2 IXL/Eureka	CC-SS 3 IXL/Eureka	CC SS-4 Ontario	CC-SS 6 Benton	CC-SS 7 Benton	CC SS 8 Haystack	CC SS 9 Unnamed	CC SS 10 Black Diamond Jay	CC SS 11 Black Diamond Jay	CC SS 12 Cornucopia
Aluminum	1370	729	3020	6100	4060	4660	12000	583	2570	14100	889
Antimony	29 2U	49 2U	35 6	11 2U	62 9	18 1	16 8	82 1	10 7B	16 5	9 9U
Arsenic	3 2B	104	46 6	183	280	112	24 9	155	178	156	94 1
Barium	44 6B	15 0B	46 6	121	87 7	57 3	473	24 2B	24 0B	213	36 9B
Beryllium	0 32U	0 26B	1 2	0 83B	0 64B	0 36B	0 94B	0 30B	0 19B	0 76B	0 23B
Cadmium	2 9B*	6 5*	6 7*	2 3*	2 3*	1 7*	4 2*	40 5*	8 0*	28 9*	18 1*
Chromium	1 8U	7 7B	2 2	49 4	11 0	14 6	9 5	0 61U	17 0	191	1 3B
Cobalt	2 7U	4 6U	0 92U	15 8	2 7B	4 5B	9 5B	3 3B	0 98U	15 6	0 93U
Copper	28 4N*	49 3N*	89 5N*	59 9N*	308N*	181N*	304N*	201N*	63 7N*	172N*	32 3N*
Iron	1690*	167000*	19000*	50800*	42400*	48500*	63500*	20300*	93900*	61200*	16200*
Lead	53 2*	2380*	5270*	177*	5020*	1180*	454*	2330*	4050*	14100*	4340*
Manganese	238	31 5	14 3	1050	108	272	320	19 7	185	575	6 6
Mercury	0 16U	0 07B	0 83	0 06U	0 49	2 8	0 77	0 40	0 30	0 28	3 4
Nickel	9 0U	3 0U	3 1U	48 5	5 0B	3 6B	7 3B	3 1U	3 2U	69 1	3 1U
Selenium	1 8U	0 62U	0 62U	0 71U	0 64U	0 63U	0 67U	0 63U	0 66U	0 65U	0 63U
Silver	2 5B	37 6	51 0	9 3	125	36 9	5 4	84 9	18 7	41 0	295
Thallium	2 1U	0 71U	0 71U	1 0B	0 72U	0 72U	0 77U	0 71U	0 75U	0 74U	11 9
Vanadium	3 1UB	4 1U	2 4UB	37 5	12 8	13 2	83 3	0 82U	4 8UB	59 5	0 82U
Zinc	156	1120	1360	472	472	255	1080	7690	1780	7480	3940

U - The material was analyzed for but was not detected above the level of the associated value The associated value is either the sample quantitation limit or the sample detection limit

N - Spike sample recovery not within control limits

B - The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL)

* - Duplicate analysis not within control limits

TABLE 14

CONTAMINANT AND HEALTH EFFECTS SUMMARY
CARPENTER AND SNOW CREEK MINING COMPLEX SITE

CONTAMINANT/MEDIA (CONCENTRATION)	HEALTH EFFECT	BACKGROUND
Aluminum Waste Rock (12 000 ppm)	Inhalation of dust will cause pulmonary fibrosis	1,370 ppm
Antimony Waste Rock (82 1 ppm)	Antimony Trioxide is a suspected human carcinogen (A2)	29.2U ppm
Arsenic Waste Rock (280 ppm)	A confirmed human carcinogen (A1)	3 2B ppm
Barium Sediment (640 ppm)	Some forms are poisonous when ingested Some forms are irritants to the eyes, nose and throat	93 6 ppm
Beryllium Waste Rock (1 2 ppm)	A suspected human carcinogen (A2)	0 32U ppm
Cadmium Waste Rock (40 5* ppm)	A suspected human carcinogen (A2)	2 9B* ppm
Chromium Waste Rock (191 ppm)	Chromate is a confirmed human carcinogen (A1)	1 8U ppm
Cobalt Waste Rock (15 8 ppm)	Animal carcinogen (A3)	2 7U ppm
Copper Sediment (3 840N* ppm)	Exposure symptoms are vomiting coma, and death	19 5 ppm
Iron Waste Rock (93,900* ppm)	Can cause liver and kidney damage, altered respiratory rates, and convulsions	1,690* ppm
Lead Waste Rock (14 100* ppm)	An animal carcinogen (A3)	532* ppm
Manganese Sediment (6 000 ppm)	Can cause central nervous system and pulmonary system damage by inhalation of dusts and fumes	289 ppm
Mercury Waste Rock (3 4 ppm)	Main effect is on the central nervous system, mouth, and gums Not suspected as a human carcinogen (A4)	0 16U ppm
Nickel Waste Rock (69 1 ppm)	There is intended change to confirmed human carcinogen (A1)	9U ppm
Silver Waste Rock (295 ppm)	Inhalation of dusts can cause skin effects and discoloration	2 5B ppm
Thallium Sediment (31B ppm)	A deadly poison via the inhalation and ingestion routes	0 84U ppm
Vanadium Waste Rock (83 3 ppm)	No information	3 1B ppm
Zinc Waste Rock (7,690 ppm)	Chromate is a confirmed human carcinogen (A1) Other forms have a low toxicity	156 ppm

The categories of carcinogenicity are according to the Chemical Substance TLV Committee which synthesizes information from a variety of sources The categories are
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Reference No 6

STATE OF MONTANA
BUREAU OF MINES AND GEOLOGY
Francis A. Thomson, Director

MEMOIR No. 13

GEOLOGY AND ORE DEPOSITS OF THE NEIHART MINING DISTRICT CASCADE COUNTY, MONTANA

BY
PAUL A. SCHAFER

MONTANA SCHOOL OF MINES
BUTTE, MONTANA
July, 1935

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CONTENTS

Page

ILLUSTRATIONS

I L L U S T R A T I O N S (continued)

T A B L E

GEOLOGY AND ORE DEPOSITS OF THE NEIHART MINING DISTRICT, CASCADE COUNTY, MONTANA

by

Paul A. Schafer

INTRODUCTION

This report is based on two months of field work accomplished during July and August, 1933. The writer was assisted in the field mapping by W C McLaughlin. Information was drawn freely from the report on "The Geology of the Little Belt Mountains, Montana," by Walter Harvey Weed.* However, since the publication of Weed's report, the district has expanded, and continuous development has opened new mines. The possibility of further improvement in metal prices focuses attention on Neihart, a district with a production record extensive from 1882 to 1929

The map accompanying this report was made with the aid of a plane table, open-sight alidade, and pacing. The presence of numerous claim corners gave occasional checks. The geology was mapped in as much detail as the outcrops permitted and veins were platted where their presence was indicated by surface or underground workings. In the occasional absence of fuller information, the trend of veins was generalized. The position of the portals of tunnels, shafts, and dumps are indicated on the map.

All accessible mine workings were mapped Many were inaccessible and information concerning them was obtained from material on dumps, from maps and sections which had been made during the operation of the property, and from smelter returns on shipments

The report describes most of the mines and some of the prospects in the district. Much of this description is from surface and underground observation, some of it is taken from Weed's account, and some of it was obtained by conversation with men who have worked in the mines Microscopic examination of the ores and rocks was pursued during the fall and winter to determine the mineralogy and the petrographic relations of the ores

*Weed, W H , The geology of the Little Belt Mountains, Montana U S Geol Survey Twentieth Ann. Rept , pt 3, pp 257-461, 1900

ACKNOWLEDGMENTS

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LOCATION AND ACCESSIBILITY

Neihart is in the central part of the Little Belt Mountains, on the headwaters of Belt Creek, Cascade County, Montana It is the terminus of a branch line of the Great Northern Railway from Great Falls, 65 miles northwest The Park to Park Highway, No 87 W, connects Neihart with Great Falls and White Sulphur Springs

The district embraces that region near Neihart which is drained by Belt Creek and its tributaries, including Rock Creek, Narrowgauge Creek, O'Brien Creek, Carpenter Creek, Snow Creek, Lucy Creek, McKay Creek, Haystack Creek, and Johnson Creek.

CLIMATE AND VEGETATION

The Little Belt Mountains, especially in the vicinity of Neihart and Monarch, are a haven of comfort to the people of the neighboring plains, whose cottage colonies, extending up and down the valley, are well patronized during the summer months. Days and nights are cool, the temperature seldom reaching 90 degrees. In winter, however, Neihart is virtually isolated except for the railroad which serves it three times a week The winter snows are very heavy

The district is well watered by rainfall and melting snow, producing timber on the slopes between altitudes of 4,000 and 7,000 feet. Open meadows, however, are not uncommon, and these furnish excellent pasturage for stock. Although much of the timber has been logged off, there remains considerable stands of pine, large enough for lagging, and a few stands which are adequate for stulls

MINERAL PRODUCTION

The Neihart district has been a relatively steady producer of silver since the time of discovery in 1881. Production before 1902 was high, valued at $4,140,000, but the slump in price beginning in 1892 and culminating in the low of 1902, caused a shrinkage in production which remained negligible until the improvement in silver prices beginning in 1917.

A second decline in silver price, beginning in 1927, had a similar effect on production. This later decline had a much more serious effect upon production than that of 1896 to 1916

With satisfactory silver prices, Neihart has never failed to be a significant producer. From this it might be inferred that with better prices a return of production is imminent This problem is discussed further on.

From 1881 to 1898 the production, as estimated by Weed, was 4,000,000 ounces of silver, $800,000 in gold, and 10,000,000 pounds of lead, with a total value of about $5,000,000 From 1904 to 1931 the total value of metals was $9,989,553 No official figures are available for the period 1898 to 1904, but $2,000,000 is considered a reasonable estimate, making the value of the total production approximately $16,989,000

H I S T O R Y   O F   M I N I N G

The discovery in 1879 of silver-bearing lead carbonates at Barker and of gold in the alluvial deposits of Yogo Gulch caused a rush to the Little Belts The discovery of silver ore at Neihart in 1881 evoked little attention. Rich carbonate ores were exploited. An ebb in activity awaited the advent of a railroad. In 1891 a branch of the Montana Central Railroad (now a part of the Great Northern system) was built to Neihart and Barker. Mining activity was revived and Neihart became the busy center of the district

A party of prospectors from Barker discovered ore at Neihart and staked the Queen of the Hills claim. The camp that grew up rapidly was named after J L Neihart and the district was called the "Montana district".

In 1882 small amounts of rich ore were packed on horseback to the Barker smelter. In 1883 the Galt and Mt Chief mines were bonded by outside capital In 1884 the Queen, Galt, Ball, and Mt Chief mines were actively developed and ore was shipped to the Omaha smelter. These shipments netted the owners $200 a ton, after deducting $100 a ton for freight and treatment.

According to Weed*, " The Mountain Chief was purchased for $18,000 by the Hudson Mining Company, which spent over $10,000 on developing the property and acquired a group of six claims. The character of the ore uncovered by these workings led to the building of a concentrator and smelter by this company in 1885-86 About 1,000 tons of concentrates and $50,000 to $60,000 worth of bullion were made. The works closed down in 1887, owing to the exhaustion of the rich surface ores and to the encountering at slight depth ore carrying but 15 to 40 ounces of silver."

In 1885 a group of claims acquired by Colonel Broadwater was consolidated to form the Broadwater mine but, after a few months of exploitation, the work was suspended,

Between 1887 and 1890 the camp was nearly deserted. The completion of the railroad in November 1891, giving cheap transportation to the smelter at Great Falls, brought new life, Several properties were developed to a stage where steady production was assured and renewed activity commenced

* Weed, W H., op cit

Unfortunately, just at that time, silver took a rapid drop in price This caused a general suspension of activity The Broadwater mine continued to work large bodies of rich galena ore and rich silver ore was profitably mined in the Florence, Benton, and Big Seven properties.

Weed gives the total production of the district up to 1898 as 4,008,000 ounces of silver, $800,000 in gold, and 10,000,000 pounds of lead.

Between 1895 and 1915 the low price of silver made it profitable to operate only the exceptionally high-grade mines. Of these the Florence, Galt, Broadwater, Big Seven, Ripple, Silver Belt, Hartley, Benton, Queen of the Hills, and Moulton were the most important. During this period three mills were sporadically operated the Morning Star, the I X L -Eureka, and the Broadwater. The Morning Star mill comprised a crusher, one set of rolls, and jigs. The I. X L -Eureka was a ten-stamp cyanidation plant. The Broadwater was a concentrator equipped with crushers and tables. In spite of these local facilities, most of the ore was shipped direct to distant smelters

In 1916 a new era began in the production from the Neihart district. The steady improvement in the price of silver, which reached a climax in 1919 of over $1 10 an ounce, enabled many of the mines to reopen. The Moulton and Broadwater properties were combined and operated under the name of Cascade Silver Mines and Mills Company. Their concentrating plant, located in Neihart, was remodeled and improved to handle 150 tons a day. The ore was sorted, shipping ore being separated from milling ore. The Broadwater tunnel was cleaned out for 2,000 feet. Other important producers at this time were the Benton, Galt, Blackbird, Silver Belt, Ripple, Alice and Hartley, Big Seven, Cornucopia, Fairplay, Florence, London, and Tom Hendricks. Most of these shipped their rich silver ore direct to smelters. Until the opening of the Silver Dyke mine, the Moulton was the largest producer during this period. Most of the others were operated on a leasing basis. The Neihart Consolidated Silver Mining Company, which operated the Hartley mine, was an important producer, shipping in 1922 an average of 800 tons a month. In the same year the Galt Mining Company shipped several thousand tons of dump material in addition to ore from the mine.

The controlling interest in the Silver Dyke property was purchased by the American Zinc, Lead and Smelting Company in 1922 and preparations were made for large scale production. A reserve of about a million tons of milling ore, containing copper, lead, and silver, was blocked out. A 500-ton flotation plant was completed in March 1923. From this time until the mine closed down in 1929, the Silver Dyke was the camp's largest producer. The Silver Dyke ore contained about 5 ounces of silver, $1\frac{1}{2}$ per cent lead, and 0.75 per cent copper*. Development work totalling more than 4,000 feet was done in 1925, the following year the mill was enlarged to a capacity of 950 tons, and the mine became the largest producer of silver in Montana outside of Silver Bow County.

Other mines active during this period (1923 to 1929) were the Big Seven, Florence, Moulton, Galt, Ripple, Queen of the Hills, Rock Creek, Silver Belt, I. X L , Broadwater, Benton, Dakota, Commonwealth, and Fitzpatrick. High-grade ore was shipped from most of these.

In 1925, relatively low-grade ore from the Queen of the Hills and from the Galt, operated by lessees, was shipped to the Timber Butte mill at Butte

*U S. Bur Mines Mineral Resources, 1925, p 640, 1928

In 1928, production from the Silver Dyke decreased and the mine was closed down in April 1929 In 1930 all mines were idle except the Silver Dyke, from which a few shipments were made by lessees. In that year silver declined to below 40 cents an ounce and the mines were forced to close. They remained idle from 1930 to the summer of 1933. In the fall of 1933 renewed activity was indicated by shipments of ore from the Minute Man group on Carpenter Creek and the building of a small mill at the Morning Star mine.

TOPOGRAPHY

The town of Neihart stands at an elevation of about 5,600 feet above sea level. Neihart Baldy rises steeply above the town to about 8,000 feet and Long Baldy to 8,493 feet. The maximum relief, therefore, is about 3,000 feet. The average elevation of the upland surfaces is about 7,000 feet, giving an average relief of less than 2,000 feet The steep slopes heighten the effect of the relief so that transportation from mines to the railroad often presents difficulties.

The area is well drained by Belt Creek and its tributaries, most of them carrying water throughout the year. Belt Creek runs in a northwesterly direction through the town of Neihart. It is fed by the waters of three streams which enter above Neihart Sawmill Creek, Chamberlain Creek, and O'Brien Creek. Below the town Rock Creek, Spring Creek, and Carpenter Creek from the east and Johnson Creek and Hartley Creek from the west enter Belt Creek. Each of these tibutaries carries water all year and Carpenter and Hartley creeks have a swift and abundant flow. Rock Creek and Spring Creek head on the west slope of Neihart Baldy and descend rapidly nearly a thousand feet within a distance of a mile. Carpenter Creek heads on the slopes of Parnell Hill, flows westward and receives the waters of Hegener Creek and Lucy Creek, which enter from the north, and joins Snow Creek which comes down from the slopes of Long Mountain Carpenter Creek drops more than 1,600 feet in the five miles of its course Snow Creek drops more than 1,000 feet in less than two miles.

In a broad way, the Little Belt Mountains have the form of a dome, rising from the plain on the east and north, and from the wide Smith River valley on the south and west. They were formed by the dissection of an uplifted plateau or dome through the vigorous erosion of radially disposed streams. Judith River, Wolf Creek, Belt Creek, and the eastern branches of Smith River have their sources in the central portion of the Little Belt dome and flow directly outward, forming a pattern like the spokes of a wheel. They cut deep, sharply defined valleys and flow rapidly down relatively steep gradients.

The Neihart district, comprising a portion of the drainage area of upper Belt Creek, lies near the center of the Little Belt dome. Belt Creek has cut into the plateau to a depth of about two thousand feet. The valley walls rise steeply to gently undulating surfaces at elevations of 7,000 to 8,000 feet above sea level. Above the relatively flat upland, stand isolated rounded, dome-shaped hills--monodnocks on an old erosion surface. Of these only Neihart Baldy and Long Mountain are within the map area of the Neihart district.

A delicate adjustment of topography to rock resistance and structure is clearly apparent in the region. The resistant Neihart quartzite stands out in bold cliffs from the walls of Belt Creek valley above Neihart. Its southeastward dip carries it to the floor of the valley, through which Belt Creek cuts a narrow canyon, about two miles above the town. Contrasted with the erosional features of the Neihart quartzite, the areas of gneisses and schists lying stratigraphically below the quartzite show smoother topographic forms, the valley walls are less steep, cliffs and steep-walled canyons are rare. Certain members of this great series of metamorphic rocks, however, are more resistant than others and stand out prominently above the surrounding smooth-featured country. This is especially true of a red feldspathic gneiss whose color and bold outcrops make it an outstanding feature of the landscape in the immediate vicinity of the town.

West of Belt Creek the upland is relatively flat because the Neihart quartzite forms a resistant floor temporarily arresting the down-cutting activity of eroding streams. The top of Long Mountain also presents a fairly level surface for the same reason.

The characteristic dendritic pattern of the drainage indicates that the stream channels originated on a domed plateau in rocks whose simple structure coincided with the domed surface. Thus, the streams achieved the dendritic pattern which, when their courses were entrenched, had to be maintained in the underlying structurally-complicated older rocks. The attempt to divert the streams from the dendritic pattern to coincide with the structure of resistant rocks, like the Neihart quartzite and red gneiss, has been operating with the result that rock structure directs the stream courses for short distances.

G E O L O G Y

PRE-BELTIAN ROCKS

These rock bodies, lying stratigraphically below the Belt series, are here called pre-Beltian* rocks, a term adopted in the description of those isolated bodies of schist and gneiss known to be older than the Belt, but which have not yet been correlated with areas of differentiated Archean and Algonkian rocks. They are highly contorted and metamorphosed and lie beneath the gently-dipping Belt rocks. The age difference between the pre-Beltian and the Beltian rocks is very great.

As yet it is impossible definitely to correlate the pre-Beltian rocks of Neihart with either the Pony series or the Cherry Creek series of the Tobacco Root and Madison mountains. The difficulty of such a correlation is increased by the fact that the Neihart gneisses and schists are dominantly of igneous origin and those of the Tobacco Root Mountains are dominantly of sedimentary origin, an original rock difference which markedly affects the later metamorphic products.

The pre-Beltian gneisses in the map area of the Neihart district occupy all but the southeastern portion, including part of the northern slopes of Neihart Baldy and Long Mountain, the contact following a line immediately above the Ripple, Benton, Big Seven, Silver Belt, and Broadwater mines. The ore bodies of these mines are for the most part within the gneiss and consequently below the Neihart quartzite which is of Beltian age. Since no

*Tansley, Wilfred, Schafer, P. A., and Hart, L. H., A geological reconnaissance of the Tobacco Root Mountains, Madison County, Montana. Montana Bureau of Mines and Geology, Memoir No. 9, 1933. (The term pre-Beltian was suggested to the authors by Dr. F. A. Thomson, Director of the Bureau of Mines and Geology.)

The ore is chiefly silver and lead, much of the latter in the form of cerussite, the lead carbonate. Barite is abundant, occurring with ankerite and quartz. Pyrargyrite and polybasite are common in the high-grade ore, and tetrahedrite, sphalerite, and galena are present. The presence of malachite, azurite, cerussite, and coatings of supergene ruby silver indicate that the ore has been secondarily enriched.

According to Mr. Faller, ore aggregating about $40,000 was formerly taken from the mine, and in recent years he has made several shipments.

The regularity of spacing of the ore shoots suggests that new bodies may be expected beyond the face of the adit, but the narrow width and small size of the shoots do not lend much encouragement to their further development.

London Mine

The London mine adjoins the Evening Star mine on the north and exposes the same vein. There are four adits which develop about 1,500 feet of the vein. None were accessible at the time of the writer's examination. The mine was operated intermittently from 1912 to 1928 and high-grade ore was shipped directly to the smelter. No production figures are available.

The vein lies entirely within the Pinto diorite. Probably the yield has been from ore enriched by supergene processes.

Blackbird Mine

This mine is on the northward extension of the Broadwater vein, between the Broadwater and the Silver Belt mines. It was worked through a cross-cut adit and drifts. Several large vein splits occur in the mine and these have yielded some ore.

The mine was operated for a short time in 1902, and again from 1915 to 1923. The net smelter proceeds were $33,960.40. The silver content of the shipments averaged near 160 ounces per ton, lead, about 10 per cent, zinc, about 10 per cent, and gold about 0.1 ounce. All of the exposed ore has been secondarily enriched.

Silver Dyke Mine

The Silver Dyke property is about 3½ miles up Carpenter Creek on the mountain slope above the forks of the creek. The lower adit is at an elevation of 6,870 feet above sea level. It is connected by a good mountain road to the railroad at the mouth of Carpenter Creek.

Development of the deposit began in the summer of 1921 and actual construction began in the fall of 1922. The American Zinc, Lead, and Smelting Company acquired controlling interest in the property and began operation in February 1923 upon the completion of a 500-ton mill. About 1,000,000 tons of milling ore were blocked out and reported to contain about 1.5 per cent lead, .75 per cent copper, and 5 ounces silver to the ton. The total cost of mining, milling, and smelting was reported to be $2.75 a ton in 1924. In 1926 the capacity of the mill was enlarged to 950 tons. In April 1929 the mine closed, apparently after the exhaustion of the ore blocked out and the failure to develop any additional large tonnage of ore. During the operation of the Silver Dyke mine, Cascade County had a greater mine production than any county in the state outside of Silver Bow.

The ore body occurs in a large mass of brecciated quartz porphyry, granite porphyry, and some brecciated gneiss The plan of the body is elliptical with a length of about 600 feet and a width of about 400 feet The developed vertical range varies from 250 to 300 feet The ore minerals occur in the interstices between the breccia fragments and to a slight extent in a fine-grained dissemination through the rock. The rock is highly altered to kaolin, sericite, and quartz.

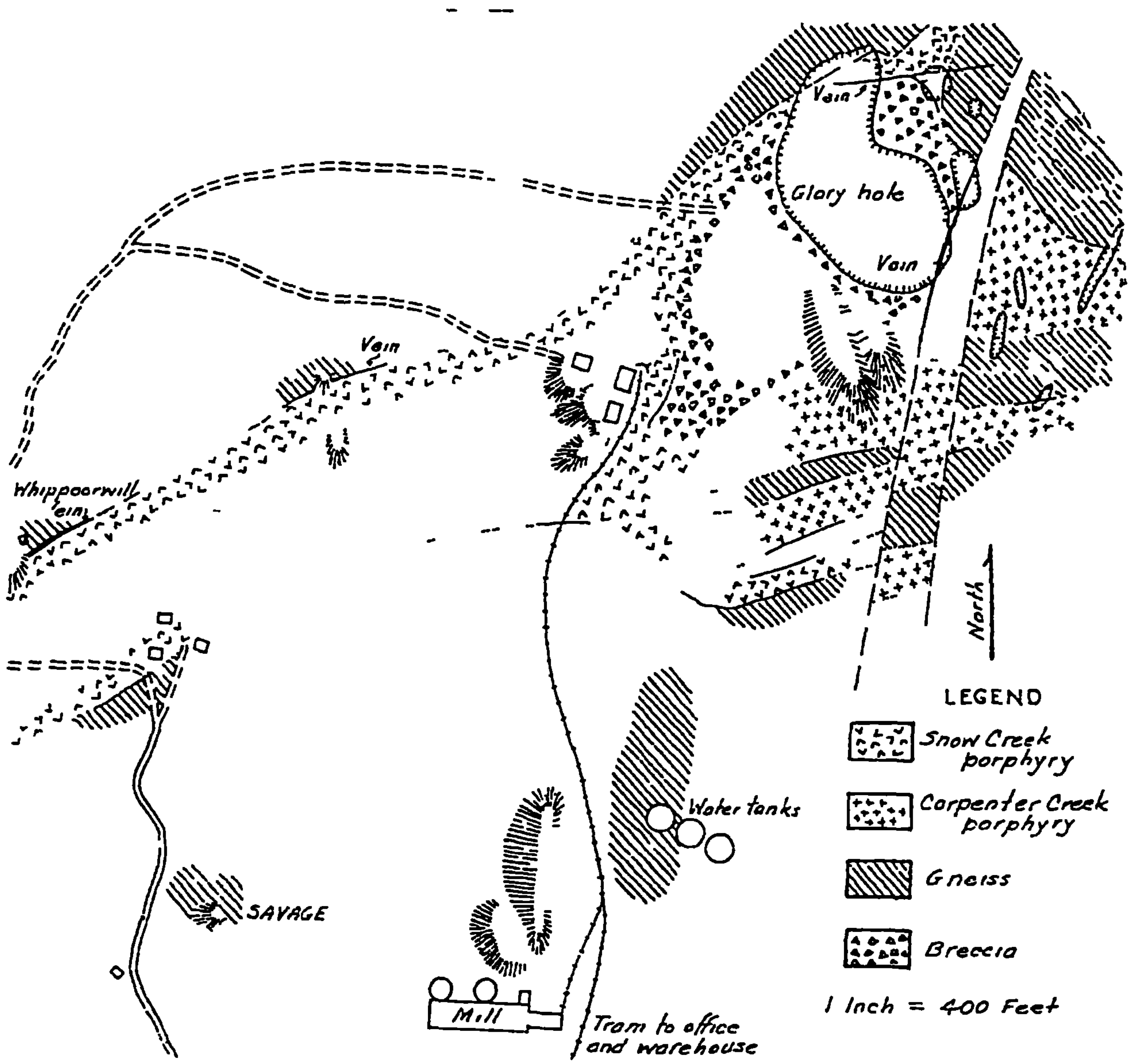


Figure 12 —Sketch map showing the geology and surface plant in the vicinity of the Silver Dyke mine

In the ore the primary ore minerals are pyrite, chalcopyrite, sphalerite, galena, and tetrahedrite Although no silver minerals were observed, galena and tetrahedrite may contain a small amount of silver, but in the case of tetrahedrite it is not sufficiently abundant to call the mineral freibergite The minerals occur in small clusters in the openings between rock fragments and in small veinlets. Quartz is the principal associate of the ore minerals in the clusters Drusy cavities are common and only rarely are former openings completely filled Several faults cut through the deposit and some of these are more intensely mineralized than the brecciated mass.

The upper portion of the deposit is partially oxidized but much of the deeper ore is primary The oxidation has produced cerussite, malachite, azurite, and iron oxides

The cause of the brecciation was not positively determined. The body occurs at a junction of a number of dikes of quartz porphyry and granite porphyry (Carpenter Creek porphyry) It is possible that the fracturing which accompanied the injection of the Carpenter Creek porphyry caused the brecciation of the brittle Snow Creek quartz porphyry Somewhat similar brecciation has occurred in an apparently analogous situation in the vicinity of Hegener Creek, where mineraliztion has also occurred in the breccia. The nearby Whippoorwill and Savage veins may have contributed to the mineralization in the capacity of feeder channels. Whether the feeders are of commercial quality beneath the brecciated zone is problematical.

The mining and concentration of the ore are discussed by George J. Young* and extracts are herein quoted from his paper

"Underground development was extended from two adits at different elevations At present the lower adit is used for working purposes This is about 1,000 feet in length, 5 feet wide at the top, 6½ feet at the bottom, and 7 feet high A 36-inch gage track has been installed, and connects to four or more parallel drifts at about 80-foot centers Two of these drifts are joined at their further extremities by a run-around, The others are dead ends, which will be extended as they are needed

"Two methods of mining are now employed, one being by open pit during the summer months, and the other being 'under cover' and restricted to the winter months or when excessive rainfall interferes with open pit operations Because of the clayey nature of the ore and its sticky properties, the open-pit mining departs from the usual glory-hole practice. The open pit was started from two pairs of vertical 5 by 5-foot raises 100 feet apart and 35 foot on centers These raises are connected with double loading chutes Each raise was reamed out to 15 feet in diameter by retreating upward. The broken ore was removed promptly from the chutes to prevent packing and hangups Thereafter, the pit was extended by blasting deep churn-drill holes spaced about the periphery of the vertical walled pit . .

' Average cost of mining over the last eight months was 42¢ per ton, which included management and overhead, but does not include development, which is about 30¢ per ton Upon a tonnage of 700 tons per day, the costs are very low

"The ore is unusual and approaches the complex type Both oxidized and sulphide minerals occur The valuable minerals are galena, cerussite, chalcopyrite, malachite, azurite, pyrite, and iron oxides, with sphalerite in small amounts Identity of the silver mineral has not been determined Gangue consists of altered quartz porphyry and gneiss, the ore containing about 20 per cent of colloidal material, principally kaolin Heads contain 0 78 per cent copper, 1 56 per cent lead, and 4 48 ounces of silver per ton. Tailings average 0 22 per cent copper 0 44 per cent lead, and 0 91 ounces of silver per ton. About 16 per cent of the lead in the heads is oxidized, and likewise, about 25 per cent of the copper In the tailings about 46 per cent of the copper is in oxidized form and 23 per cent of the lead The recovery, considering the physical nature of the ore as well as its chemical composition, is excellent— 72.94 per cent of the copper, 73 09 per cent of the lead, and 80 55 per cent of the silver. The ratio of concentration is 13 15 tons of ore to 1 ton of concentrates

*Young, G J , Novel mining and milling methods at the Silver Dyke property at Neihart, Montana Eng. and Min Jour , vol 123, No 6, p 236-241, Feb 5, 1927,

" Two products are made, a lead concentrate and a copper concentrate, the former being shipped to the East Helena smelter and the latter to Anaconda.

" Concentrates are hauled in 5-ton, solid tire, White trucks to the railroad loading station $3\frac{1}{2}$ miles away at a cost of $1 50 per ton, up freight is handled at $2 per ton "

The present and future value of the Silver Dyke depends upon the development of bodies of ore of milling quality which may be mined selectively on a more modest scale than that employed by the Silver Dyke Mining Company. It is probable that the success of that enterprise depended upon three things low cost of operation, high base metal prices, and supergene enrichment near the surface The present metal prices and the depletion of supergene ores indicate that further mining of this deposit must be selective Numerous masses of low-grade ore still exist in the mine, exposed in the workings of the haulage level and other openings. The Savage and Whippoorwill veins may yield ore, but because these were inaccessible during the writer's examination, no positive statement can be made here concerning them

Hegener Group

This group of 10 claims is in and near the valley of Hegener Creek, a north tributary of Carpenter Creek. The property is owned by John Hegener of Great Falls Production, according to Mr Hegener, has been between $25,000 and $30,000, most of it during the early life of the district. A few small shipments were made in 1922. Shipments contained from 30 to 300 or more ounces of silver to the ton

There are numerous veins on the property of which the most important are the Vilipa, Gold Rock, Copper Queen, and Baker Most of the workings are now inaccessible and information concerning them has been furnished by Mr Hegener

The Vilipa vein has a northwest strike and crosses Hegener Creek nearly at right angles. A shaft was sunk in 1902 on the vein to a depth of 115 feet and from the bottom a drift extends 300 feet southeasterly An adit, now caved, follows the vein for a distance of 400 feet southeasterly. The ore contained silver, gold, zinc, lead, and a trace of copper Polybasite has been observed in ore from this vein

The Gold Rock vein trends north and south, partly beneath the bed of the creek It was developed from the bottom of a 100-foot shaft by a drift extending 50 feet north It is reported to be a wide vein with a high-grade "streak" from which ore was shipped that averaged 100 ounces silver, 8 per cent copper, and 6 to 7 per cent lead to the ton. An adit was driven on the vein for a distance of 265 feet The principal ore minerals are galena, chalcopyrite, sphalerite, and tetrahedrite (possibly freibergite). Native silver, ruby silver, and native copper have been observed

The Copper Queen vein strikes north-south and has been developed by an adit 165 feet long and a 100-foot cross-cut which cuts the vein. The vein contains chiefly silver and copper as valuable constituents The main ore minerals are chalcopyrite, tetrahedrite, galena, sphalerite, and native silver

On the Baker claim is a 75-foot cross-cut adit which cuts a wide low-grade mineralized zone containing chalcopyrite.

silver content is low. The possibility of developing large tonnages of low-grade milling ore is not remote, but most of the high-grade that could be profitably shipped direct to the smelter has probably been extracted

Big Ben Group

This group of claims, on the north slope of Poverty Ridge a short distance above the junction of Carpenter and Snow creeks, is owned by Frank Mansikka, of Neihart. The ore is disseminated molybdenite in Snow Creek quartz porphyry. Development consists of an upper and lower adit respectively 250 and 325 feet long and 100 feet apart vertically. According to Mr. Wade V Lewis, who sampled the ore, the material averages about 0.5 per cent MoS_2 with several zones of better quality.

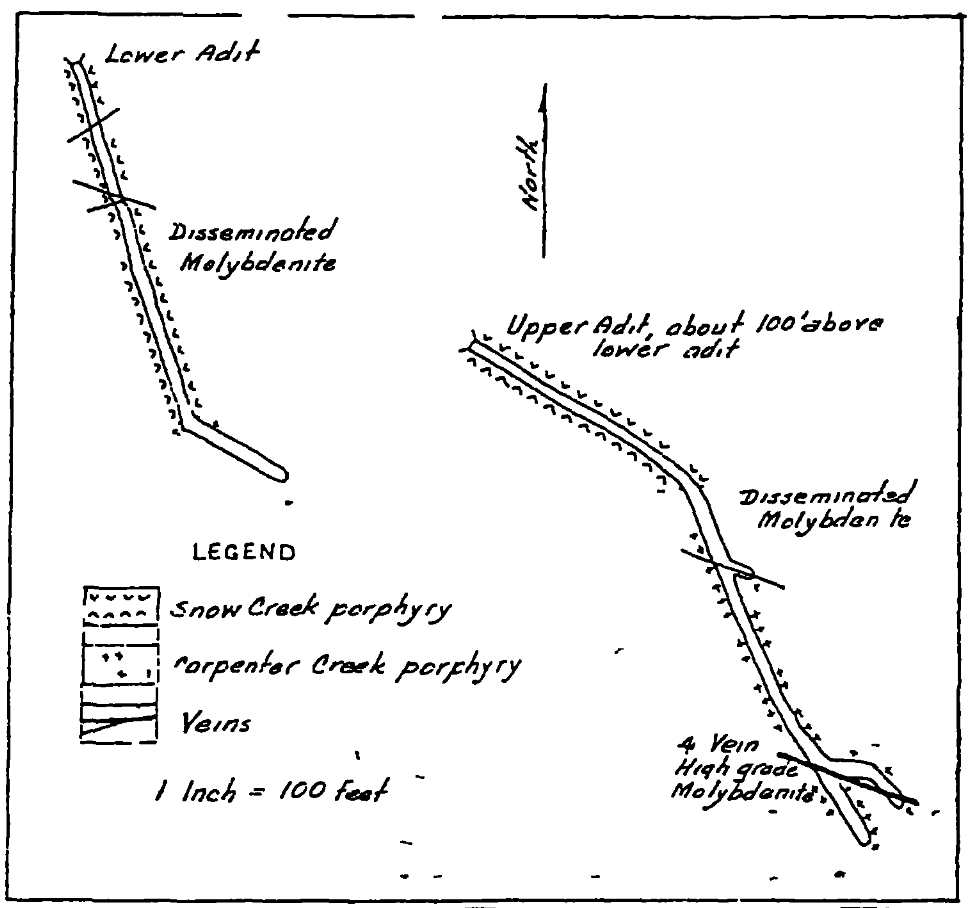


Figure 14 --Geologic map of the workings in the Big Ben molybdenite deposit.

The presence of molybdenite is not restricted to the Big Ben group, but it can be found within the Snow Creek porphyry in many places. Fine specimens have been taken from the White Elephant claim on Snow Creek, and it is common in the vicinity of Hegener and Mackey creeks. It is not improbable that commercially mineable bodies may be found

Big Seven Mine

This mine is in Snow Creek valley on the north slope of Neihart Baldy Mountain at elevations between 7,000 and 8,000 feet above sea level and about 2,000 feet above Belt Creek. It is accessible from the railroad by a good road up Carpenter Creek about 1½ miles and a poor mountain road up Snow Creek about 1½ miles farther.

The ground was located in the eighties and before 1898 it had been a large producer of rich silver ore with high gold content. Early shipments contained from 100 to 500 ounces of silver and $20 to $50 in gold per ton. Since that time the mine has been an intermittent producer up to 1921 Mr. D L S Barker, who operated the mine during its most productive period, states that the total production has been in excess of $1,000,000 Although the writer has no production statistics, the magnitude of the workings and the high-grade tenor of the ore indicate that production was probably near $1,000,000.

The vein is developed by three adits, the upper two on the vein and the lower a cross-cut and drift. The upper adit ("Pierce tunnel"), is 200 feet above the middle tunnel, and extends into the mountain 800 feet along the vein It is now inaccessible. The middle or "Glover" tunnel is about 2,200 feet long and developed stoping-ground about 800 feet long. It is 550 feet above the lower adit. The lower adit is a cross-cut for about 800 feet until it encounters the vein which it then follows for about 2,000 feet. Several sub-levels were driven below the middle tunnel from a winze which later was connected to the lower tunnel by a raise. Considerable mining was done from the lower tunnel in two ore shoots, each about 600 feet horizontal length A winze was sunk to a depth of 200(?) feet below the lower tunnel from a point about 1,500 feet in from the portal. The middle tunnel is now accessible for about 1,200 feet where a cave blocks it. The lower tunnel is open for a distance of about 1,800 feet (1933).

The vein cuts Pinto diorite, gneiss, and Snow Creek quartz porphyry. It is narrow and less productive in the Pinto diorite--from a few inches to 2 feet in width. In the gneiss it widens to 6 feet. The ore is contained in one or more narrow high-grade stringers cutting the main vein, sometimes along the center, but usually along one or both walls These high-grade "streaks" vary in width from a few inches to a foot or more. Much of the vein matter is more or less crushed rock, highly sericitized, silicified, and sprinkled with sulphides.

The ore is highly siliceous--carbonates are rare except in the lower part of the mine where ankerite becomes locally abundant. Lead and zinc were so rare in the shipments from the upper part of the mine that they were neglected in the smelter statements. Both lead and zinc are present, however, and in the lower levels they occur to the extent of several per cent. The ratio of gold to silver varies from 1 ounce gold to 60 ounces silver, to 1 ounce gold to 140 ounces silver, the average being 1 to 100.

The ore minerals are chiefly pyrite, galena, sphalerite, proustite, and pearceite (possibly also polybasite). A small amount of tetrahedrite (or freibergite), chalcopyrite, molybdenite, and arsenopyrite have been observed microscopically. Most of the high-grade ore specimens examined under the microscope showed a brecciation of sphalerite, pyrite, and quartz, with an interstitial filling of later galena, ruby silver, tetrahedrite, quartz and a little carbonate, thus suggesting the possibility of vein reopening at a critical time to receive the deposition of the valuable constituents.

It is not likely that large bodies of high-grade shipping ore have been left in the mine, but the possibility of developing considerable ore of milling quality is not remote. One difficulty is the small width of the productive portion of the vein, 1 to 3 feet, but this material might be sorted before entering the mill. Ore shoots will be largely limited to that portion of the vein which cuts gneiss, because it is seldom productive in the Pinto diorite, and as the Pinto diorite-gneiss contact is extremely irregular, the downward persistance of ore shoots cannot be predicted.

Benton Mine

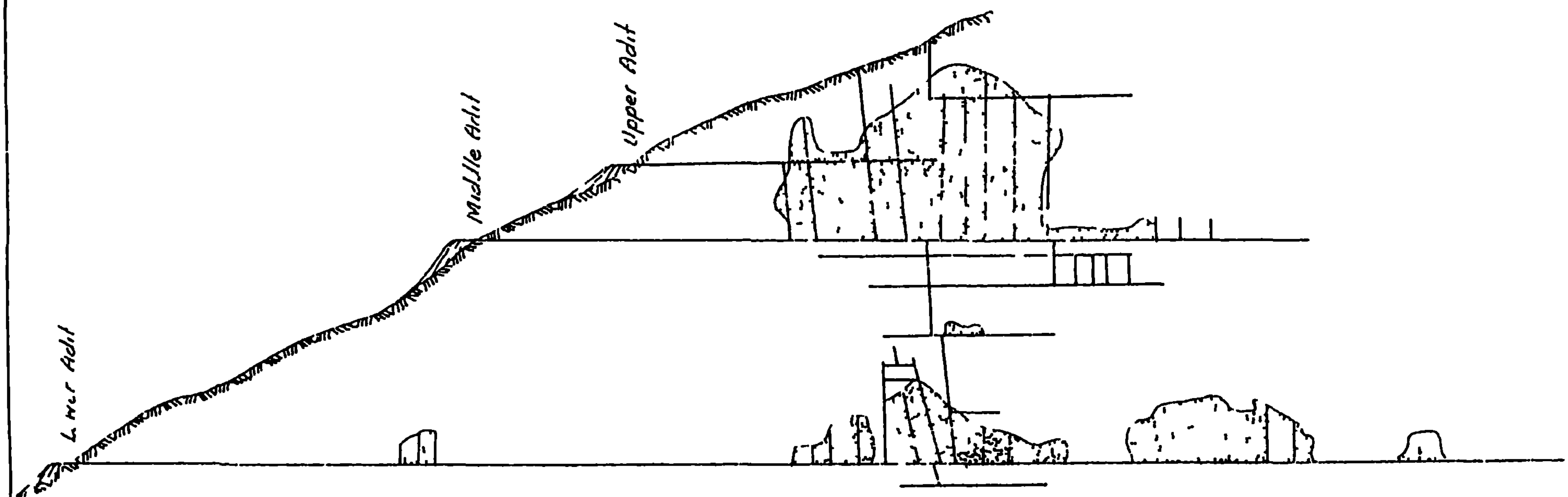
This mine is in the upper Snow Creek valley just east of the Big Seven "This was for many years the largest producer of high-grade ores of the camp, and the gold contents were so considerable that the mine was profitably worked from 1892 to 1896 despite the general depression in silver properties. . The only workings visited in 1893 were those of the new tunnel or uppermost adit of the mine These workings nowhere cut entirely through the vein, exposing the walls The vein matter is a bluish decomposed gneiss, carrying pyrite. The ore, though but a few inches in width, was very rich, consisting of loosely compacted sulphides with native silver. The hanging wall of the tunnel, which is driven on the lead, shows Pinto diorite, and the foot wall a quartzose gneiss, but the vein crosses both rocks and is not a contact lode

"In the summer of 1897 the high-grade ore bodies of the vein were reported exhausted and active development work was suspended, though a couple of leasors were extracting some galena ore from the stopes near the face of the lower tunnel . .*The main adit level is 2,400 feet long and is driven on the vein. In this* lower tunnel the vein is from 3 to 6 feet wide, and shows walls of both gneiss and Pinto diorite, the former prevailing where the ore shoots occur and the vein pinching to a few inches in width in the latter rock The vein is a breccia or gneiss, which is in places checked and sandy, but more generally is altered to a soft clay-like material, so that the mine workings are wet and muddy. The Benton ore has been unusually high grade, the values being chiefly in gold, with some silver, but the bodies at the end of the new tunnel consist of lead ore, generally zincky and low grade. In the third tunnel the vein carries ore in bunches and not big shoots. In the main lead the values were largely in gold. The tunnel is said to cut two leads. The ore produced in the past has been much like that of the Big Seven One carload netted $26,000, according to Mr. D. C E Barker, and the total product of the mine had exceeded $400,000 in 1898."*

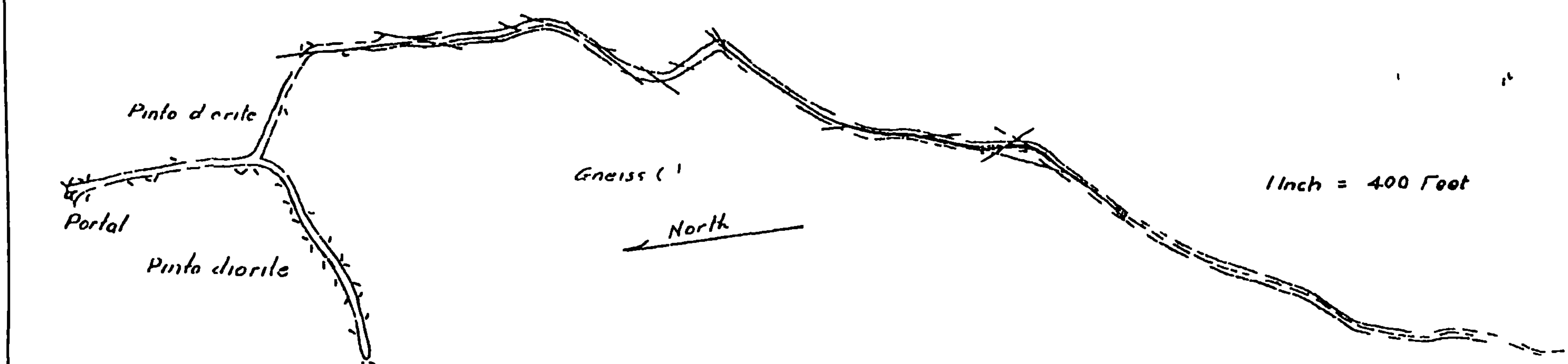
Only a small amount of mining was done by lessees after 1905. Small shipments of ore were made during 1908, 1910, 1911, 1915, 1923, and 1924, but no systematic operation has been attempted since the early work described above.

At the time of the writer's examination the workings were inaccessible and the dumps gave the only clue to the mineralogy of the ores, Pyrite occurs abundantly, and the material is rather silicious, apparently somewhat similar to the ore of the Big Seven. Grab samples of material from the dumps averaged about

*Weed, W H , op cit , pp 436-437



A LONGITUDINAL SECTION SHOWING STOPES, BIG SEVEN MINE



B PLAN OF LOWER ADIT LEVEL BIG SEVEN MINE

Tom Hendricks Mine

The Tom Hendricks is a claim fraction on the Ripple vein adjoining the Ripple claim The ore shoot occurs at the junction of the vein with the capping of Neihart quartzite. The mine was worked by Mr J. J Stewart who produced about $60,000 worth of ore from it

Cornucopia Mine

This mine consists of 14 patented claims on upper Snow Creek, owned by James E Murray and H Lowndes Maury, of Butte At present (May 1935) it is being developed by lessees Several veins have been partially developed by a 250-foot shaft, 300 feet of drifts, and a 300-foot adit. The country rock is grey granite gneiss near the contact with Pinto diorite. Only a few carloads of ore have been shipped. The ore is interesting because of the unusually high gold content relative to silver.

SUMMARY AND CONCLUSIONS

The mines of the Neihart district conveniently divide themselves into three distinct geographic and geologic units the Neihart unit, the Carpenter Creek unit, and the Snow Creek unit The deposits of each division, as they are exposed by mining operations, exhibit mineral and structural features which catalogue them as definite portions, or segments, of a continuous zonal sequence. The individual characteristics of each zone have been described in a previous chapter, and it remains to evaluate their potentiality as future metal producers In this connection it is not the purpose of the writer to definitely and finally condemn or endorse, but to suggest, on the basis of the geologic evidence, programs which appear to deserve consideration and thorough examination.

It is improbable that large reserves of high-grade ore exist in any of the old mines, but the presence of considerable tonnages of low-grade material, consisting largely of zinc ore, has been proved in several properties, and is suspected in many more. Why, then, has not this low-grade ore been exploited? In the first place, rich ore has been available in the past, which, by careful sorting, could be concentrated to a grade that would profitably stand the costs of direct shipment to smelters, in spite of deductions for zinc. Secondly, veins are relatively small and mining costs high, and, with the exception of a few of the larger mines, the installation of milling equipment was considered an unsound investment In most cases the mill would be far from the mine and haulage would be costly. Thirdly, the process of selective concentration of the products of complex ores was not as efficient as it is today. A fourth, and very important factor in causing the general "shut-down" of the mines, was the rapid drop in metal prices, especially in the price of silver, in 1929 and 1930.

The former practice of sorting the "ore streak" from the mined material has placed on dumps large quantities of vein-stuff which contains from 2 to 20 ounces of silver and a little lead and zinc. From time to time the dumps have been picked over and the selected material shipped to smelters or milled locally. Scattered dump samples taken by the writer indicate that much of the "waste," since it is already mined, is now ore which might be profitably exploited by the use of proper methods of concentration. Bodies of low-grade ore have been left in many mines during the careful selection of rich material practiced by early miners The downward extension of ore shoots depends chiefly on the continuance of suitable structures, a condition that cannot be ascertained without underground exploration, but assuming such continuance, the zonal indications favor downward extension, with an increase in base metals and decrease in silver.

In order to mine the low-grade ores, zinc must be transformed from a liability to an asset. This can be achieved by modern methods of selective flotation in which a mill unit produces a zinc concentrate. The Timber Butte mill, at Butte, by this process, handled low-grade ore from Neihart at very low cost. The Comet mill, near Basin, produces zinc concentrate, lead concentrate, and pyrite (iron) concentrate. The zinc concentrate is sent to Great Falls, and the remainder to East Helena. In this way zinc yields a profit instead of a penalty.

A milling program calls for the development of sufficient tonnages of ore to maintain continuous and efficient production. Few single veins at Neihart are capable of supplying, at the desired rate, the ore demanded for this, and yet, by taking the veins together in groups, this may be accomplished. The following discussion is based on the theory that in the collective operation of closely associated groups of veins, there is hope of an economy of production that could not be accomplished by the former wasteful old-time methods of individual selective mining of high-grade portions of veins.

THE NEIHART SLOPE

The plan of mining and milling ore from a group of veins in this locality is not new. Something of that idea may have prompted the Neihart Consolidated Mining Company to start their Compromise tunnel from the village. Mr. Jesse L Maury examined the district in 1929 with the same idea in mind At present (1935), with the encouragement given by an improved silver price, such a program again comes to the front.

The portal of the Compromise tunnel (adit) is not well situated for adequate dump room and mill site, but this could be remedied by starting the adit on Rock Creek at about the same elevation. The Compromise tunnel, continued along the Moulton fault, would cut the Broadwater vein about 280 feet below the No 8 level, cutting, on the way, the Hartley vein, Rock Creek vein, and numerous other veins on the ground of the Neihart Consolidated Mining Company. The total length of this cross-cut adit would be about 3,500 feet. By serving the double purpose of drainage level and haulageway for the Hartley and Broadwater mines much economy of operation could be achieved. By the consolidation of the Broadwater, Hartley, Rock Creek, Moulton, and possibly the Galt, sufficient mill-feed may be maintained to supply a larger concentrator than would be possible by individual operations, thus affecting a considerable saving in milling costs. Of course, a large initial expenditure for development must precede the design and construction of a mill.

SNOW CREEK

In this area three formerly producing mines are ideally disposed for a single large operation the Big Seven, Benton, and Ripple mines. From the lower adit of the Big Seven, a 2,000 foot cross-cut would cut the other veins. However, it might be necessary to place the mill on main Snow Creek in order to get sufficient water, and in this case a tram haulageway would be required. The probability of the presence of considerable ore of milling quality is great enough to warrant a thorough examination with the idea of mining at least two and possibly all three veins as a unit

CARPENTER CREEK

On account of the inaccessibility of the mines in this area (especially on Hegener Creek), the writer can say little regarding the quantity or quality of the ores. Some bodies of zinc-lead-silver ore appear to merit careful examination. Possibly three or four deposits on Hegener Creek could be handled as a unit in conjunction with a mill, but thorough geologic investigation and considerable new development would be necessary to determine the feasibility of that enterprise

HAROLD L ICKES Secretary

BUREAU OF MINES

R R SAYERS Director

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commercial minerals, thereby providing producers and consumers of mineral products with the means for following short-time changes in conditions of supply and demand of the leading mineral commodities Thus, the Bureau of Mines would materially enhance its service of providing the earliest and most complete official data covering the fundamental economic phases of the mineral industry

R R SAYERS, *Director*

JUNE 25, 1940

CONTENTS

INTRODUCTION

Although the trend of business for the first 5 months of 1939 was downward, the year as a whole showed a marked improvement over 1938 The index of the volume of industrial production of the Federal Reserve Board, generally accepted as the most reliable business indicator, was 106 for 1939, an advance of 23 percent from 86 in 1938 This index, adjusted for seasonal variation, was 101 in January but dropped to 92 in April and May Beginning in June it started a steady rise indicative of substantial improvement in virtually all lines of business In the last quarter, under the impetus of actual and anticipated war orders, the index remained above 120 and actu-

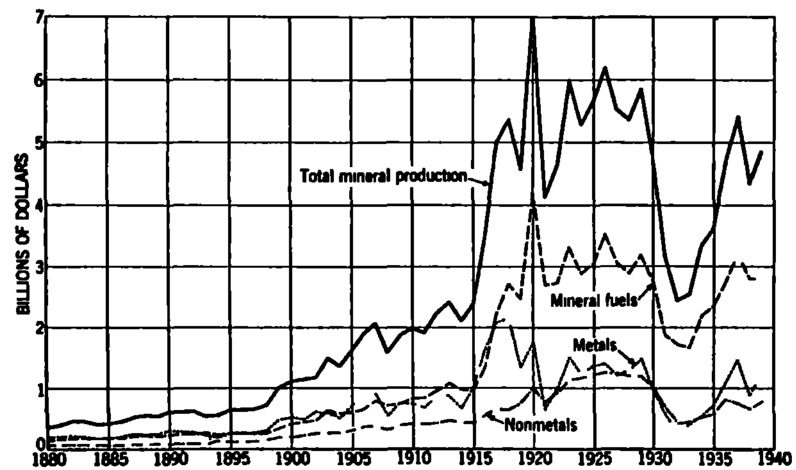

FIGURE 1 —Mineral production of the United States 1880-1939

ally reached an all-time peak of 128 in December This spurt was short-lived, for the index slumped sharply for the first 4 months of 1940 before turning upward in May

Mineral production did not advance as rapidly in 1939 as business in general, although the index for the year was 108, 2 points higher than that for all industrial activity In 1938 the spread was quite pronounced—99 for minerals and 86 for industrial activity The preliminary total value of mineral production in the United States in 1939, as reported to the Bureau of Mines by producers, was $4,874,000,000, an increase of 12 percent from $4,362,900,000 in 1938 Metals, as a group, led with a rise of 45 percent in value, followed by nonmetals (other than fuels) with 18 percent, fuels decreased 0 06 percent

The steel industry paced the industrial advance of the closing months of 1939, with production rising to a peak of 94 4 percent of

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By T H Miller and Paul Luff

SUMMARY ~~OUTLINE~~

Insert No. 2

The total value of the output of recoverable metals in Montana in 1939 increased $12,841,124 or 46 percent, over 1938 Substantial gains were recorded in both quantity and value of each of the five metals, the value of copper increased $5,214,268, zinc $2,770,072, gold $2,130,100, silver $2,028,598, and lead $698,086 The gain of $9,376,536 in Silver Bow County (from $18,300,823 in 1938 to $27,677,359 in 1939) represented 73 percent of the total State gain and was made possible by reopening of the zinc mines and increased output from the copper mines of the Anaconda Copper Mining Co at Butte There were important increases in output of siliceous ores, chiefly gold ore, from several counties The gain from placer mines was notable

All tonnage figures are short tons and "dry weight", that is, they do not include moisture

The value of the metal production herein reported has been calculated at the following prices

Prices of gold, silver, copper, lead, and zinc, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0 71875	$0.083	$0 040	$0.044
1936	35 00	7745	092	046	050
1937	35 00	7735	121	059	065
1938	35 00	[4] 646+	098	046	048
1939	35.00	[5] 678+	104	047	052

[1] Price under authority of Gold Reserve Act of Jan 31 1934 Treasury legal coinage value of gold from Jan 18 1837 to Jan 31 1934 was $20 67+($20 671835) per fine ounce

[2] 1935–37 Yearly average weighted Treasury buying price for newly mined silver 1938 39 Treasury buying price for newly mined silver

[3] Yearly average weighted price of all grades of primary metal sold by producers

[4] $0 64646464 [5] $0 67878787

Mine production of gold, silver, copper, lead, and zinc in Montana, 1935–39 and total, 1862–1939, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1935	681	551	2 41[illegible] 113	161 088 03	$5 288 081	9 322 951	$6 700 871
1936	570	284	3 85[illegible] 116	180 209 20	6 307 322	11 600 563	8 984 636
1937	615	406	4 8[illegible] [illegible]09	202 252 00	7 078 820	11 812 093	9 136 654
1938	482	265	2 7[illegible]4 [illegible]66	203 313 00	7 115 955	6 403 962	4 139 935
1939	594	282	3 [illegible]92 780	264 173 00	9 246 055	9 087 571	6 168 533
1862–1939			(1)	16 161 441 00	350 103 647	688 454 936	503 598 112

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	1[illegible] 957 470	$12 861 470	31 177 [illegible]	$1 247 101	18[illegible] 561 477	$4 820 705	$30 918 228
1936	219 [illegible] 000	20 153 096	38 11[illegible] 000	1 753 428	99 [illegible] 000	4 971 700	42 173 182
1937	289 0[illegible] 000	34 975 776	35 [illegible]14 000	2 118 928	78 33[illegible] 000	5 091 840	58 402 016
1938	154 42[illegible] 000	15 133 748	18 654 [illegible]00	858 084	17 [illegible]88 000	849 024	28 096 746
1939	195 [illegible]64 000	20 348 016	3[illegible] 110 000	1 556 170	69 598 000	3 619 096	40 937 870
1862–1939	[2] 5 783 030	1 099 118 600	[2] 582 947	61 780 542	[2] 1 586 370	239 058 968	2 853 659 869

[1] Figures not available [2] Short tons

Gold and silver produced at placer mines in Montana, 1935–39, in fine ounces, in terms of recovered metals

Year	Sluicing hydraulic and drift		Dragline and dry land dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1935	4 586 48	647	9 031 88	1 554	12 680 87	1 294	26 299 23	3 495
1936	2 803 02	338	18 312 43	3 393	19 300 35	1 923	40 415 80	5 654
1937	2 989 00	369	15 844 00	4 249	17 564 00	1 797	36 397 00	6 415
1938	3 896 00	351	10 096 00	2 943	21 356 00	3 240	35,348 00	6 534
1939	2,283 00	252	18 901 00	4 659	33 815 00	6 723	54 999 00	11 634

[1] A floating washing plant supplied with gravel by a dragline excavator is called a dragline dredge a stationary or movable washing plant supplied with gravel by any type of power excavator is called a dry land dredge

Gold—The output of gold in Montana increased to 264,173 fine ounces in 1939—the largest output since 1887, when 289,212 ounces were produced Gold from lode mines increased 41,209 ounces and that from placers 19,651 ounces Gold from Jefferson County increased 11,804 ounces, from Madison County 11,505 ounces, and from Lewis and Clark County 10,997 ounces, substantial gains were recorded also in Broadwater, Deer Lodge, Granite, and Silver Bow Counties Most of the gain from placer mines came from the new bucket dredges of the Winston Bros Co and the Perry-Schroeder Mining Co, which were placed in operation late in 1938 Large gains in output of gold were reported at the Southern Cross, Victoria, Ohio Keating, and Golden Sunlight mines and at the Butte properties of the Anaconda Copper Mining Co Siliceous ores yielded 72 percent of the State total gold in 1939 and placers 21 percent Ore treated at amalgamation and cyanidation mills yielded 31 percent of the gold, crude ore shipped direct to smelters 33 percent, and ores treated at concentration mills 15 percent The output of gold ore increased to 815,949 tons in 1939 (compared with 756,223 tons in 1938), it comprised 82,359 tons treated at amalgamation plants, 490,429 tons treated at cyanidation plants, 148,138 tons treated at concentration plants, and 95,023 tons shipped crude to smelters

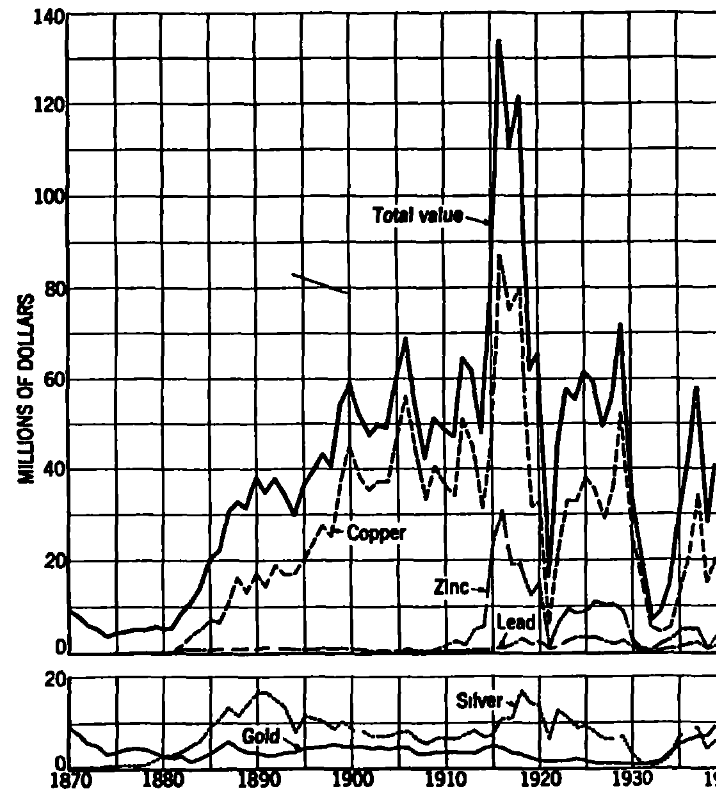

FIGURE 1 —Value of mine production of gold silver copper lead and zinc and total value in Montana 1870–1939

The West Mayflower property (Madison County) of the Anaconda Copper Mining Co in 1939 again was the largest gold producer in Montana, it was followed by the Winston dredge near Clancey, the Ruby Gulch mine at Zortman, the Victoria mine at Silver Star, the Butte Highlands mine in Silver Bow County, the Butte properties of the Anaconda Copper Mining Co, the Porter dredge at Helena, the Jardine mine in Park County, the Golden Messenger mine in Lewis and Clark County, and the Southern Cross mine in Deer Lodge County These 10 properties yielded 105,665 ounces of gold in 1939

Silver —The output of recoverable silver in Montana was 9,087,571 fine ounces in 1939 compared with 6,403,962 ounces in 1938 and 11,812,093 ounces in 1937 Most of the gain in 1939 was in Silver Bow County (6,114,455 ounces produced in 1939 compared with 4,018,192 ounces in 1938) and was due to reopening of the zinc mines and to increased output from the copper mines of the Anaconda Copper Mining Co The production of silver from Jefferson, Cascade, and Granite Counties also increased substantially Copper ore yielded 52 percent of the State total silver in 1939, zinc-lead ore 20 percent, and silver ore 18 percent Nearly 79 percent of the silver came from ores treated by concentration and 19 percent from ore sent direct to smelters Silver from zinc-lead ore increased 1,331,843 ounces and that from copper ore 838,344 ounces The output of silver ore increased 26,962 tons and that of gold-silver ore 48,172 tons

The Anaconda Copper Mining Co was in 1939, as usual, the chief silver producer in Montana—the copper and zinc units at Butte and the Flathead mine yielding nearly 70 percent of the State total Other important silver producers included the Comet mine near Basin, the Granite Bimetallic and Silver Prince mines near Philipsburg, the Big Seven and Florence mines at Neihart, the Hecla mine in Beaverhead County, and the West Mayflower mine in Madison County

Copper —Copper ore, the most valuable mineral product of Montana, yielded recoverable gold, silver, and copper valued in all at $23,621,484 in 1939, or 58 percent of the total value of the metal output of the State The Anaconda Copper Mining Co was, as usual, the only important producer of copper in Montana, the output of recoverable copper from company mines at Butte increased 27 percent over 1938, owing to increased rate of operations during the last 4 months of 1939, but it was considerably less than the output in 1937 The company shipped 2,197,863 tons of copper ore to the mill at Anaconda compared with 1,561,186 tons in 1938 and 3,068,665 tons in 1937

Lead and zinc —The Anaconda Copper Mining Co resumed production of zinc-lead ore from the zinc mines at Butte in March 1939, after a shut-down of more than a year, zinc shipments were resumed in December at the Emma mine, leased by the company As a result, the output of zinc-lead ore in Montana increased to 320,248 tons in 1939 from 114,769 tons in 1938, with proportionate increases in production of all five metals There was a decrease in zinc-lead ore from the Jack Waite mine, but an increase from the Comet mine Zinc-lead ore from Granite County increased slightly but was much less than in 1937, as no zinc-lead ore was produced at the Trout property Concentrates smelted yielded 60 percent of the State total lead and 64 percent of the zinc in 1939, crude ore smelted yielded 32 percent of the lead, and slag fumed yielded nearly 8 percent of the lead and 36 percent of the zinc There was an increase in lead from crude ore smelted, chiefly from the Flathead mine in Flathead County and the Glendennin property in Judith Basin County

MINE PRODUCTION BY COUNTIES

Mine production of gold silver, copper, lead, and zinc in Montana in 1939 by counties in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	40	11	11 570	$404 950	181 718	$123 348
Broadwater	48	28	19 901	696 535	31 170	21 164
Carbon		1	1	35		
Cascade	11		2 078	72 730	438 374	297 563
Deer Lodge	13	5	9 866	345 310	11 251	7 637
Fergus	8	3	3 185	111 475	3 465	2,352
Flathead	3		614	21 490	473 846	321 641
Gallatin	2	1	6	210	9	6
Granite	50	17	14 283	499 905	693 028	470 419
Jefferson	96	18	30 984	1 084 440	553 192	375 500
Judith Basin	3		109	3 815	38 529	26 153
Lewis and Clark	62	41	45 854	1 604 890	122,265	82 992
Lincoln	5	9	1 944	68 040	11 024	7 483
Madison	153	24	61 875	2,165 625	231 308	157 009
Meagher	2	16	395	13 825	112	76
Mineral	4	20	1 072	37 520	56	38
Missoula	12	22	2,258	79 030	2 805	1 904
Park	5	5	8 627	301 945	7 375	5 006
Phillips	2	3	18 196	636 860	74 443	50 531
Powell	24	28	8 895	311 325	68 475	46 480
Ravalli	5	8	171	5 985	3 306	2 244
Sanders	8	2	155	5 425	27 219	18 476
Silver Bow	37	20	22 036	771 260	6 114 455	4 150 418
Sweet Grass	1		29	1 015	134	91
Toole		5	69	2 415	3	2
	594	282	264 173	9 246 055	9 087 571	6 168 533
Total 1938	482	265	203 313	7 115 955	6 403 962	4 139 935

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	199 394	$20 737	763 064	$35 864			$584 899
Broadwater	22 731	2 364	422 319	19 849			739 912
Carbon							35
Cascade	9 250	962	586 425	27 562	10 000	$520	399 337
Deer Lodge							352 947
Fergus	38	4	383	18			113 849
Flathead	3 404	354	5 533 553	260 077			603 562
Gallatin	58	6	5 830	274			496
Granite	134 981	14 038	445 192	20 924	1 326 404	68 973	1 074 259
Jefferson	391 721	40 739	4 003 787	188 178	2 142 308	111 400	1 800 257
Judith Basin	11 231	1 168	1 566 745	73 637	22 000	1 144	105 917
Lewis and Clark	39 173	4 074	3 324 531	156 253	25 278 000	1 314 456	3 162 665
Lincoln	4 798	499	83 809	3 939			79 961
Madison	91 606	9 527	211 383	9 935			2 342 096
Meagher	1 500	156	1 532	72			14 129
Mineral							37 558
Missoula	17 461	1 816	8 639	406			83 156
Park	58	6	30 318	1 425			308 382
Phillips	1 760	183					687 574
Powell	3 875	403	127 000	5 969			364 177
Ravalli	2 308	240	21 234	998			9 467
Sanders	184 182	19 155	6 558 915	308 269	787 000	40 924	392 249
Silver Bow	194 533 471	20 231 481	9 415 341	442 521	40 032 288	2 081 679	27 677 359
Sweet Grass	1 000	104					1 210
Toole							2 417
	195 654 000	20 348 016	33 110 000	1 556 170	69 598 000	3 619 096	40 937 870
Total 1938	154 426 000	16 133 748	18 654 000	868 084	17 688 000	849 024	28 096 746

Gold and silver produced at lode mines in Montana in 1939, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*
Beaverhead	57,245	9 497	181 553	Meagher	10		31
Broadwater	70,389	17 338	30 718	Mineral	204	25	3
Cascade	44,482	2 078	438 374	Missoula	1,500	002	2 671
Deer Lodge	29,825	9 842	11 251	Park	52,919	8 416	7 347
Fergus	51,695	3 168	3 465	Phillips	12,785	18 179	74 443
Flathead	26,560	614	473 846	Powell	15,319	4 393	67 974
Gallatin	26	1	9	Ravalli	284	63	3 303
Granite	123,405	13 281	692 941	Sanders	37,491	140	27 219
Jefferson	128,423	14 455	546 595	Silver Bow	2,498,928	21 912	6 114 433
Judith Basin	2,738	109	38 529	Sweet Grass	144	29	134
Lewis and Clark	327,990	25 676	119 684		3 792 780	209 174	9 075 937
Lincoln	14,569	1 095	11 018	Total 1938	2 724 466	167 965	6 397 428
Madison	190,119	57 666	230 396				

Gold and silver produced at placer mines in Montana in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dragline and dry land dredges[1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	63	5	4		2,006	160			2 073	165
Broadwater	186	31	25	2	2 357	428			2,568	461
Carbon	1								1	
Deer Lodge	24								24	
Fergus	17								17	
Gallatin	5								5	
Granite	94	10	24		127	6	757	71	1 002	87
Jefferson	78	20			6 330	2,873	10 121	3 704	16 529	6 597
Lewis and Clark	290	60			4 682	881	15 206	1 640	20 178	2 581
Lincoln	93				156	6			249	6
Madison	169	19	80	17	10	2	3 950	874	4 209	912
Meagher	94	12	7		294	69			395	81
Mineral	243	6	23		781	47			1 047	53
Missoula	71		1		1 584	134			1 656	134
Park	211	28							211	28
Phillips	6				11				17	
Powell	259	17	5		457	50	3 781	434	4 502	501
Ravalli	2				106	3			108	3
Sanders	15								15	
Silver Bow	124	22							124	22
Toole	30	2	39	1					69	3
	2 075	232	208	20	18 901	4 659	33 815	6 723	54 999	11 634
Total 1938	[2]3 896	[2]351	([2])	([2])	10 006	2 943	21 356	3 240	35 348	6 534

[1] A floating washing plant supplied with gravel by a dragline excavator is called a dragline dredge a stationary or movable washing plant supplied with gravel by any type of power excavator is called a dry land dredge

[2] Figures for sluicing and hydraulic include those for drift mining

MINING INDUSTRY

Reopening of the zinc mines and increased output from the copper mines of the Anaconda Copper Mining Co at Butte accounted for most of the gains in metal output in Montana in 1939, however, increases were reported in gold ore treated at amalgamation and cyanidation mills, and there was a marked increase in crude gold ore shipped direct to smelters

Gold recovered at placer mines in Montana increased 19,651 fine ounces over 1938 Seven connected-bucket dredges were in operation during 1939 and handled 7,435,147 cubic yards of gravel yielding 33,815 ounces of gold and 6,723 ounces of silver, the recovered gold was valued at $1,183,525, indicating an average value of 15 9 cents to the cubic yard of gravel treated Dragline or power-shovel excavators with dry-land or floating washing plants were reported in operation at 49 properties, the plants treated 4,377,813 cubic yards of gravel, which yielded 18,901 ounces of gold and 4,659 ounces of silver, the gold recovered was valued at $661,535, indicating an average value of 15 1 cents to the cubic yard

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver

Ore sold or treated in Montana in 1939 with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	379	815 949	179 610	448 893	172 622	848,853	
Dry and siliceous gold silver ore	36	55 620	5 491	287 304	94 266	142 512	
Dry and siliceous silver ore	82	177 892	5,477	1 606 840	282 886	1 461 541	
	[1] 495	1 049 461	190 578	2 343 037	549 274	2,452,906	
Copper ore	9	2,253 270	7 636	4 697 920	[2] 193 897 430		
Lead ore	91	23 096	2,296	214 368	51 271	9 831 863	
Zinc ore	3	[3] 146,705	16	38 452	5 631	2,518 578	25 399 604
Zinc lead ore	19	320 248	8 648	1 782,180	1 150 394	18 306 658	44,198,396
Total lode mines	[1] 594	3 792,780	209 174	9 075 937	[2] 195 654 000	33 110 000	69 598 000
Total placers	282		54 999	11 634			
	876	3 792 780	264 173	9 087 571	[2] 195 654 000	33 110 000	69 598 000
Total 1938	747	2 724 466	203 313	6 407 962	[4] 164 426 000	18 654 000	17 688 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes
[2] Includes 4 004 361 pounds recovered from precipitates
[3] Includes 145 638 tons of current slag fumed
[4] Includes 5 563 800 pounds recovered from precipitates

METALLURGIC INDUSTRY

Lode mines in Montana produced 3,792,780 tons of ore and old tailings in 1939 compared with 2,724,466 tons in 1938. The output in 1939 comprised 82,359 tons treated at amalgamation mills, 490,429 tons treated at cyanidation mills, 2,836,478 tons treated at concentration plants, 237,876 tons shipped crude to smelters, and 145,638 tons treated at a slag-fuming plant.

Two combined cyanidation and concentration mills and 19 straight cyanidation mills were operated in Montana in 1939; the ore and old tailings treated increased from 433,233 tons in 1938 to 490,429 tons in 1939. The material treated in 1939 contained 79,132 ounces of gold and 223,654 ounces of silver and the bullion and concentrates produced yielded 68,349 ounces of gold and 126,153 ounces of silver, indicating average recoveries of 86 percent of the gold and 56 percent of the silver. Fifteen of the mills, treating 464,412 tons of material, reported the consumption of 286,302 pounds of 91-percent sodium cyanide, 69,876 pounds of calcium cyanide, 80,560 pounds of zinc dust (including zinc shavings used at one plant), and 3,725,537 pounds of lime, in addition, two plants used 1,103 pounds of lead acetate and one plant used 5,270 pounds of manganese dioxide.

Ore treated at straight concentration plants increased from 1,976,828 tons in 1938 to 2,836,478 tons in 1939. The 1939 total comprised 148,138 tons of gold ore, 43,600 tons of gold-silver ore, 125,262 tons of silver ore, 2,197,863 tons of copper ore, 300 tons of lead ore, 1,067 tons of zinc ore, and 320,248 tons of zinc-lead ore.

Details of the treatment of all ores produced in Montana in 1939 are given in the tables that follow.

Mine production of metals in Montana in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	82,359	9 354	2 042			
Ore cyanided	490 429	68,278	126 015			
Concentrates smelted [1]	500 204	44 614	7 177 059	187 408 271	19 914 836	44 320 000
Copper precipitates smelted	2,007			4 004 381		
Ore smelted	237 876	86 928	1 747 220	4 151 368	10 683 164	
Slag fumed	145 638		23 601		2 512 000	25 278 000
Placer		54 999	11 634			
		264 173	9 087 571	195 654 000	33 110 000	69 598 000
Total 1938		203 313	6 403 962	154 426 000	18 654 000	17 688 000

[1] Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion: Gold	Recovered in bullion: Silver	Concentrates smelted and recovered metal: Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	50	21	2					
Broadwater	1 442	1 032	189	59	131	327	242	840
Deer Lodge	2 391	122	17					
Granite	355	70	41	6	21	8		
Jefferson	1 030	136	38	64	98	600	921	6 104
Lewis and Clark	770	129	31					
Lincoln	14 485	1 145	257	306	415	10 573	4 618	75 196
Madison	7 914	1 501	600	146	506	1 087	1 105	438
Mineral	175	2		7	10			
Missoula	900	178	33	18	122	31	46	
Park	52 295	4 908	797	2 128	3 291	825		
Powell	451	71	35					
Ravalli	66	33						
Sanders	35	7	2	6	26	35		
	82,359	9 354	2 042	2,800	4 620	13 486	6 932	82,578
Total 1938	77 478	9 492	2 050	1 599	2 639	5 687	1 559	20,158

CYANIDATION MILLS

County	Material treated	Recovered in bullion: Gold	Recovered in bullion: Silver	Concentrates produced	Gold	Silver	Copper	Lead
Beaverhead	38,195	7 365	1 968	6	60	12		
Deer Lodge	18 986	2 908	327					
Fergus	51 552	3 089	1 927					
Granite	12,612	2 965	103					
Lewis and Clark	158,243	18 683	40 909	16	11	126	40	9 860
Madison	62 356	8,083	16 245					
Phillips	128 981	15 249	63 592					
Silver Bow	19 504	9 936	804					
	490 429	68 278	126 015	22	71	138	40	9 860
Total 1938	433 233	64 759	120 062					
Grand total 1939	572 788	77 632	128 057	2 822	4 691	13 624	6 972	92,438
1938	510 711	74 251	122 112	1 599	2 639	5 687	1 559	20 158

Mine production of metals from concentrating mills in Montana in 1939, by counties in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal: Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	63 622	7 780	10 846	6 499	13 858	88 871	
Cascade	44 117	1 543	1 465	355 667	7 525	559 084	10 000
Granite	82,612	26,382	2 508	385 480	105 445	381 203	1 326,404
Jefferson	108 736	15 288	5 584	479 192	357 904	3 004 727	2,142 308
Judith Basin	54	37		251		11 800	22,000
Lewis and Clark	14 065	450	2 032	5 069	14 515	344 862	
Madison	65 941	3 304	7 351	15 255	78,863	1 591	
Park	500	47	2	5 673	58	30,318	
Powell	5 000	496	535	4 145	1 112	75 527	
Sanders	36 028	3 744	51	21 334	28 975	5 249 074	787 000
Silver Bow	2 415 693	438 277	9 523	5 884 547	186 882 044	9 415,341	40 032,288
Sweet Grass	110	19	26	114	1 000		
	2 836 478	497 382	39 923	7 163 435	187 491 299	19 822,398	44 320 000
Total 1938	1 976 828	351 779	32 061	4 718 975	145 431 136	11 237 033	5 561 167

Gross metal content of concentrates produced from ore mined in Montana in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	11 720	18,467	12,578	28 305	95,674	
Dry gold silver	23 753	1 881	156 791	78 517	58 738	
Dry silver	1 408	2,001	323 060	6 022	67 331	
Copper	384 480	9 882	4 598,779	190 572,750		
Lead	15 123	5 592	761 328	547 848	16 107 608	412,837
Zinc	44 743	2,961	1 140 326	625 687	3 610 356	49 243 452
Iron (from zinc lead ore)	18,977	3 830	184 197	222 084	1 026 757	1 984 502
	500 204	44 614	7 177 059	192,081 213	21 026 464	51 640 791
Total 1938	353 378	34,700	4,724 662	148,646,904	11 740 075	7 682 163

Mine production of metals from Montana concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	6	60	12			
Broadwater	7 845	10 977	7 126	14 100	89 711	
Cascade	1 543	1 465	355 567	7 525	559 084	10 000
Granite	26,388	2,529	385 497	105 445	381 203	1 326 404
Jefferson	15 352	5,682	479 792	358 825	3 670 831	2,142,308
Judith Basin	37		951		11 800	22,000
Lewis and Clark	475	2,043	5 195	14 555	354 722	
Lincoln	366	415	10 573	4 618	75 196	
Madison	3 450	7 857	16 342	79 968	2,029	
Mineral	7	10				
Missoula	18	122	81	46		
Park	2 175	3 293	6 498	58	30 318	
Powell	496	535	4 145	1 112	75,527	
Sanders	3 750	77	21 369	28 975	5 249 074	787 000
Silver Bow	438 277	9 523	5 884 547	186 882 044	9 415 341	40 032,288
Sweet Grass	19	26	114	1 000		
	500 204	44 614	7 177 059	187 498 271	19 914 836	44 320 000
Total 1938	353 378	34 700	4 724 662	145 432,695	11 257 191	5,561 167

BY CLASSES OF CONCENTRATES

Dry gold	11 720	18,467	12,578	21 309	92,046	
Dry gold silver	23 753	1 881	156 791	76 063	29 539	
Dry silver	1 408	2,001	323 060	5 118	64 638	
Copper	384 480	9 882	4 598 779	186 131 629		
Lead	15 123	5 592	761 328	485 665	15 520 349	
Zinc	44 743	2,961	1 140 326	594 385	3,429 816	44,320 000
Iron (from zinc lead ore)	18,977	3,830	184 197	204 042	778,448	
	500 204	44 614	7 177 059	187 498 271	19 914 836	44 320 000

Gross metal content of Montana crude ore shipped to smelters in 1939 by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	95 023	76,564	277 484	132,857	293 934
Dry and siliceous gold silver	12 020	3,610	130 513	44 494	117 668
Dry and siliceous silver	52,630	2,796	1 018 344	318 257	842,293
Copper	55 407	1 682	109 817	4 040 027	
Lead	22 796	2 276	211 062	60 887	10 204 938
	237 876	86 928	1 747 220	4 496,522	11 458 833
Total 1938	160 118	59 014	1 541 297	3 612,552	6 262,349

Mine production of metals from Montana crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	19 001	2 051	179 551	199 394	763 064
Broadwater	5,265	5 324	23,403	8 631	332 008
Cascade	315	613	82,807	1 725	27 341
Deer Lodge	8 448	6 812	10 907		
Fergus	143	79	1 538	38	383
Flathead	26 560	614	473 846	3 404	5 538 553
Gallatin	26	1	9	58	5,830
Granite	27 826	7 717	307 300	29 536	63 989
Jefferson	18,657	8 638	66 765	32 896	332 956
Judith Basin	2 679	109	38 278	11 231	1 554 945
Lewis and Clark	9 274	4 821	49 888	24 618	457 809
Lincoln	84	135	188	180	8 613
Madison	44 408	40 225	197 209	11 638	209 354
Meagher	10		31	1 500	1 532
Mineral	29	13	3		
Missoula	700	302	2,607	17 415	8 639
Park	124	215	52		
Phillips	804	2 930	10 851	1 760	
Powell	7 868	3 787	63 794	2,763	51 473
Ravalli	168	30	3 303	2 308	21 234
Sanders	1 428	56	5 848	155 207	1 309 841
Silver Bow	63 725	2 453	229 022	3 647 066	
Sweet Grass	34	3	20		
	237 876	86 928	1 747 220	4 151 368	10 683 164
Total 1938	160 118	59 014	1 541 297	3 429 505	5 977 679

BY CLASSES OF ORE

Dry and siliceous gold	95 023	76 564	277 484	56 365	245 919
Dry and siliceous gold-silver	12 020	3 610	130 513	18 203	112 973
Dry and siliceous silver	52 630	2 790	1 018 344	189 890	520 351
Copper	55 407	1 682	109 817	3 835 740	
Lead	22,796	2 276	211 062	51 170	9 803 921
	237 876	86 928	1 747 220	4 151 368	10 683 164

Mine production of gold, silver, copper lead, and zinc in Montana in 1939 by counties and districts, in terms of recovered metals

County and district	Mines producing: Lode	Mines producing: Placer	Ore sold or treated	Gold: Lode	Gold: Placer	Gold: Total	Silver: Lode	Silver: Placer	Silver: Total	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaverhead County													
Argenta	15	1	34 814	6 986	4	6 990	7 313		7 313	884	37 915		$251 488
Bald Mountain	2		488	100		100	333		333	327	10 298		4 244
Bannack	6	4	4,995	1 338	2 031	3 369	1 108	159	1 267	29			118 778
Big Hole	5	5	879	200	25	225	1 230	3	1,233	1 481	161 872		16 474
Blue Wing	5		1 074	65		65	30 631		30,631	98	1 042		23 126
Bryant	1		13 321	798		798	126 692		126,692	194 039	551 787		160 041
Elkhorn	2		45	3		3	1,102		1,102	2 538	150		1 124
Horse Prairie Creek		1			13	13		3	3				457
Polaris	1		18				436		436				296
Vipond	3		722	7		7	12,708		12,708				8,871
Broadwater County													
Backer	5	23	234	783	2,498	3,281	548	442	990	452	213		115 564
Beaver	15		15 979	2 891		2 891	10 112		10,112	7 779	116,936		114,354
Cedar Plains	12		50 932	11 539		11 539	2 126		2,126	10 413	4,596		406 607
Park	16	5	3 184	2 120	70	2,190	17 932	19	17 951	4,087	300 574		103 387
Carbon County Clark Fork		1			1	1							35
Cascade County Montana	11		44 432	2 078		2,078	438 874		438 874	9 250	586 425	10 000	399 337
Deer Lodge County													
French Gulch		3			16	16							560
Georgetown	7		29 136	9 676		9 676	1 077		1 077				339 391
Lost Creek		1			6	6							210
Oro Fino	4		846	161		161	4 262		4,262				8 528
Silver Lake	2		343	5		5	5 912		5,912				4,188
Warm Springs		1			2	2							70
Fergus County													
Cone Butte	2		25	18		18	78		78	9			684
North Moccasin	1	3	51 552	3 089	17	3 106	1 927		1 927				110 018
Warm Springs	5		118	61		61	1 460		1,460	29	383		3 147
Flathead County Hog Heaven	3		28,860	614		614	473 846		473 846	3 404	5 533 553		603 562
Gallatin County													
Eldridge		1			5	5							175
Elk Creek	1		6	1		1				19			37
Johnson Gulch	1		20				9		9	39	5 830		284
Granite County													
Alps	1		29	16		16	3		3	48			567
Boulder	9	3	754	509	38	547	1,174	3	1,177	2,856	6,894		20 565
Dunkleberg	3		23	6		6	283		283				402
First Chance	12	6	2,857	2,782	796	3 578	2,883	75	2,958	1,827	489		127 451
Flint Creek	9		104,470	5,071		5,071	681 752		681 752	129 154	4.6,809	1 326 404	743 185
Gold Creek	3	4	75	53	41	94	31	3	134				3 313
Henderson	1	1	205	82	104	186	196	3	199	952			6,744
Maxville	3		541	99		99	5,959		5,959	19	256		7 524
Moose Lake	2		23	15		15	196		196		744		698
Red Lion	2		12,618	2,976		2,976	106		106				104,232
Rock Creek	4	3	1,808	1 669	23	1,692	352	3	355	125			59 474
Stony	1		4	3		3	6		6				109
Jefferson County													
Amazon	5		127	33		33	1 457		1 457	211	16 787		2,955
Bigfoot	2		26	29		29	249		249	212	1 213		1,263
Boulder	6	1	178	24	63	87	1 622	9	1 631	134	9 086		4,593
Cataract	24	8	63,517	6 125	71	6 196	403,889	19	403,908	278,952	3 343 383	2 140 500	788,484
Clancey	3	7	31	17	12,955	12 972	212	4 536	4,748	125	297		457 270
Colorado	14		51,866	1,256		1,256	123,171		123,171	107 385	517 851	1,808	163,168
Elkhorn	10		745	323		323	2,136		2,136	875	17 809		13,683
Golconda	1		15	7		7	59		59	10	957		331
Homestake	3		18	9		9	25		25				332
Lowland	1	1	40	17	3,245	3,262	3	2,005	2,008				115,533
McClellan Creek	1		21	2		2	554		554	168	234		474
Mitchell	3	1	318	337	195	532	831	28	859	616	128		19 273
Warm Springs	5		264	216		216	856		856	923	2,915		8,374
Whitehall	17		10 947	5,998		5,998	11,416		11,416	1,827	90 553		222,125
Willow Creek	1		310	62		62	115		115	288	2,574		2,399
Judith Basin County													
Barker	2		2,719	109		109	38,454		38,454	11,183	1,560 299	22,000	105,558
Running Wolf Creek	1		14				75		75	48	6,446		359
Lewis and Clark County													
Dry Gulch	2	7	46,327	8,278	39	8,317	8,216	3	8,219	221	511		296,721
Greenhorn	2	4	23	4	141	145	140	19	159	57	2,872		5,324
Heddleston	1		1,397	280		280	12,394		12,394	8,481	14 596		19 781
Helena	14	7	57 512	3,105	9,341	12,446	6,821	878	7,699	1,760	111,425		446,266
Jefferson Gulch	1		19	13		13	9		9				461
Lake Helena	1		49	13		13	62		62	86	2,235		611
Lincoln	1	7	40	57	211	268	22	28	50	183			9 433
Marysville	18	6	40,680	6,744	3,953	10 697	27 552	750	28,302	17 106	363 233		412,457
Missouri River		6			6,396	6,396		850	850				224,437
Rimini	8	3	1,772	348	95	443	18,091	53	18,144	10 019	315,.66		43,704
Scratch Gravel	6		464	456		456	1,737		1,737	779	574		17 247
Smelter	1		145,638				23,601		23,601		2,512,000	25,278,000	1,448,540
Spokane Hills	1		55	47		47	59		59	96	319		1 710
Stemple	5	1	34,022	6,331	2	6,333	20 893		20,893	356	915		235,917
Wolf Creek	1		2				87		87	29	85		66
Lincoln County													
Libby	1	8	64	123	236	359	50	6	56	96	149		12 620
Sylvanite	4		14,505	1,572		1,572	10 968		10,968	4,702	83,660		68 886
Ural		1			13	13							455

e production of gold, silver, copper, lead, and zinc in Montana in 1939, by counties and districts in terms of recovered metals—Continued

County and district	Mines producing: Lode	Mines producing: Placer	Ore sold or treated	Gold: Lode	Gold: Placer	Gold: Total	Silver: Lode	Silver: Placer	Silver: Total	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Madison County													
Cherry Creek	3		294	341		341	8,443		8,443				$17 666
Norris	31	3	32,336	8,303	1,169	9,562	13,717	168	13,885	2,221	43,022		346,348
Pony	18		65,170	7 397		7 397	12,394		12,394	78,904	5,276		275,762
Renova	7		21,742	20,180		20,180	113,401		113,401	231			783,367
Rochester	9		1,985	480		480	2,527		2,527	625	88,277		23,406
Sheridan	25	11	2,012	1,641	150	1,791	8,079	28	8,107	1,413	27 362		69 621
Silver Star	13		43,093	13,163		13,163	19 931		19 931	2,144	12,021		475,022
Tidal Wave	15	3	1,511	2,241	8	2,249	6,441		6,441	4,606	24,234		84,705
Virginia City	26	6	9,940	3,317	87	3,404	41,110	9	41,119	1,135	8,510		147 569
Washington	5	1	1,781	513	2,795	3,308	1,544	707	2,251	327	2,681		117 468
Willow Creek	1		[illegible]				1,709		1,709				1,160
Meagher County													
Atlanta Creek		1			5	5							175
Beaver Creek		10			354	354		75	75				12,441
Camas Creek		1			14	14		3	3				492
Castle Mountain	2		10				31		31	1,500	1 532		249
Thompson Gulch		4			22	22		3	3				772
Mineral County													
Cedar Creek	1	20	28	10	1,047	1,057	3	53	56				3[illegible] 033
Gold Mountain	1		175	12		12							420
St Regis	2		16	3		3							105
Missoula County													
Coloma	8		1,026	490		490	296		296	346	22		17 388
Elk Creek		9			1,420	1,420		131	131				49,7[illegible]9
Nine Mile	1	13	2[illegible]0	95	236	331	34	3	37				11,610
Wallace	3		354	17		17	2,341		2,341	17 115	8,617		4,[illegible]69
Park County													
Crevasse	1		1,165	134		134	25		25				4,707
Emigrant Creek		3			196	196		28	28				6,879
New World	3		512	7		7	5,694		5,694	58	30 318		5,541
Sheepeater (Jardine)	1		51,241	8,275		8,275	1,628		1,628				290,730
Yellowstone River		2			15	15							525
Phillips County Little Rockies	2	3	129 785	18,179	17	18,196	74,443		74,443	1,760			687 574
Powell County													
Big Blackfoot	3	4	298	200	30	230	442	3	445	135	298		8,380
Douglas Creek		1			6	6							210
Nigger Hill	9	3	5,382	669	12	681	7 696		7,696	1,615	87 065		33,320
Ophir		1			58	58		3	3				2,032
Pioneer	1	9	450	64	3 903	3 967	34	442	476				139 168
Race Track	2		38	26		26	25		25				9[illegible]7
Washington Gulch	3	10	50	56	493	549	78	53	131	1 029			19 411
Zozell	6		173	3,3[illegible]8		3,378	59 699		59 699	1 096	39 617		160 729
Ravalli County													
Curlew	[illegible]		147	27		27	3 300		3,300	2 308	21 234		4 423
Eight Mile	1		21	3		3	3		3				107
Overwich	2	3	60	33	108	141		3	3				4,937
Sanders County													
Eagle	1		37 041	57		57	25 706		25 706	30 82[illegible]	6,503 298	87 000	369 229
Plains	2		14	3		3	140		140	19	1,128		255
Revais Creek	1		287	46		46	389		389	153 336			17 821
Trout Creek	4		149	34		34	984		984		54 489		4,419
Vermillion		2			15	15							525
Silver Bow County													
Butte or Summit Valley	[illegible]9		2,4[illegible]8,557	11 899		11,899	6,097 933		6,097 933	194,532,961	9 415 341	40 032,288	27 311 296
Divide Creek	4		180	22		22	2,920		2,920	510			2,805
German Gulch		5	[illegible]		72	7[illegible]		3	3				2 522
Highland	3	4	19 368	9 945	7	9 952	1 488		1 488				349 330
Independence	1		622	46		46	12,092		12,092				9 818
Lost Child		1			2	2							70
Silver Bow Creek		10			43	43		19	19				1 518
Sweet Grass County Independence	1		144	[illegible]9		29	134		134	1 000			1 210
Toole County Gold Butte		5			69	69		3	3				2,417
Total Montana	594	28[illegible]	3 [illegible]92 780	209 174	54,999	264,173	9 0[illegible]5 937	11 634	9 [illegible]8[illegible] 5 1	195,654 000	33,110,000	69 598,000	40 937 870

356

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BEAVERHEAD COUNTY

Argenta district—The value of the metal output from mines near Argenta decreased $50,817 in 1939, owing chiefly to a decrease of nearly 1,000 ounces in gold from the Ermont property The mine and 100-ton cyanidation mill were operated regularly by Ermont Mines, Inc, 33,163 tons of gold ore were milled, but the gold content was considerably lower than 1938 Despite the smaller output of gold, the mine was again the chief producer in Beaverhead County Shipments of gold ore from the Shafer mine were continued, but the output was much less than in 1938 Other producing lode mines in the Argenta district (all producing ore shipped crude to smelters) included the Goldfinch, Ground Hog, Iron Mountain, Jack & Rosemont, Lookout, May Day, Midnight, Oro Fino, Pay Day, Pine Tree, and Silver Horn The placer output of the district came from sluicing about 400 cubic yards of gravel at the Watson Gulch property

Bald Mountain district—In 1939 lessees operating the Faithful group shipped gold ore to a custom cyanidation mill at Bannack and gold ore and lead ore to smelters

Bannack district—There was an increase in gold from placer operations in the Bannack district in 1939, but this gain was more than offset by decreased output from lode mines The Golden Messenger Corporation surrendered its lease on the Sleeping Princess (I B) property of the New York-Montana Mines Co at the end of 1939, the output during the year comprised 305 tons of gold ore shipped to smelters and 570 tons treated in the cyanidation mill, but the output of gold decreased more than 1,300 ounces The Bannack-Apex Mining Co operated the Hendricks (Graeter) property the entire year and treated 3,975 tons of ore in the 50-ton cyanidation mill, the mill also handled custom ore from several mines in the area Other producing lode mines in the Bannack district included the Garnet, Gold Bug, Gold Crown, and Wallace The Ralph E Davis Syndicate operated the dragline and floating washing plant on Grasshopper Creek from April to December, treating 1,125,000 cubic yards of gravel, the equipment used comprised a 5-cubic yard dragline and a 1¼-cubic yard dragline and two electric-powered washing plants with a combined capacity of 7,000 cubic yards a day Nearly 2,000 ounces of gold were produced in 1939, a marked increase over 1938, but the gravel handled was of unusually low grade, as about 75 percent of the 1939 yardage was old dredge tailings A small hydraulic plant at the Dark Horse placer washed about 20,000 cubic yards of gravel Placer gold was recovered also from small-scale sluicing operations at two properties on Grasshopper Creek

Big Hole district—In 1939 lessees operating the Star property on Meadow Creek 3 miles west of Wise River shipped 200 tons of gold ore to the smelter at Anaconda, crude ore was shipped to smelters from the Dark Horse and S S & R mines, and a little gold ore from the North Star mine was amalgamated Small-scale placer operations were reported at the Carlin, Pierce Arrow, Rabbit Gulch, and Cherry Blossom properties

Blue Wing district—The entire output from the Blue Wing district in 1939 was siliceous silver ore shipped to smelters from the Blue Wing, Del Monte (Bonaparte), Ingersoll, New Departure, and Randall properties

Bryant district—The Hecla mine west of Melrose was in 1939, as usual, the only producer in the Bryant district, the output comprised 13,350 tons of silver ore and 171 tons of lead ore shipped to smelters, a marked increase over 1938

Elkhorn district—A car of copper ore was shipped from the Old Elkhorn mine in 1939, and a test lot of silver ore was produced at the Up Two property

Horse Prairie Creek district—Several hundred cubic yards of gravel were treated in a power loader and stationary washing plant at the Golden Leaf placer late in 1939

Vipond district—Lessees at the Lone Pine & Argyle Silver property of the Quartz Hill Mining Co shipped 712 tons of silver ore in 1939 to the smelter at Anaconda, silver ore was shipped also from the Monte Cristo and Triangle mines

BROADWATER COUNTY

Backer district—The value of the metal output from the Backer district increased $76,802 in 1939, most of the gain was in gold from placer mines The Fair Play Placers, Inc, was the chief placer producer in the district, the company operated a 2¼-cubic yard dragline and floating washer, having a daily capacity of 4,000 cubic yards, at property in Confederate Gulch from March 1 to December 23 and treated about 600,000 cubic yards of gravel The Empire Gulch Mining Co (formerly Charles L Sheridan) operated a 2¼ cubic yard dragline and dry-land washing plant at the Boulder Bar placer from April 10 to September 10 and treated 100,000 cubic yards of gravel Other producing placers in the district included the Antler, Armstrong, Boulder, Bourbon, Eldorado Bar, Homestead, Magpie Gulch, North Star, Rattlesnake Bench, Rose, and Tenderfoot properties Most of the output from lode mines in the district came from the Superior mine, where unusually rich gold ore was treated in a small amalgamation plant, gold ore was shipped to smelters from the Cooper, Harriett, and Satellite mines

Beaver district—Lessees continued to operate at the Custer mine near Winston in 1939, the output of gold from crude ore and from concentrates from the 60-ton flotation plant was more than double that in 1938 The rest of the Beaver district output was crude ore shipped to smelters, it comprised gold ore from the Black Tail, Chicago, East Pacific, Edna, Iron Age, Martha Washington, Midas, Mystery, Stolen Sweets, Triumph, and Vosburg mines and lead ore from the Monte Cristo and Stray Horse mines

Cedar Plains district—The value of the metal output from mines in the Cedar Plains (Radersburg) district in 1939 increased $183,077 over 1938, owing chiefly to marked increase in gold from the Ohio Keating mine, the property was operated the entire year by the M & M Mining Co, and 25,321 tons of gold ore were treated in the rebuilt (80-ton) flotation plant The C G Gold Corporation continued regular operations at the Keating group, the output comprised 3,473 tons of concentrates (from 23,301 tons of gold ore treated in the 100-ton flotation plant) and 2,210 tons of crude gold ore shipped to smelters Other producers in the district included the Apex, Black Friday, Comstock, Cyclone, Emma, Gopher, and Spar mines

Park district—The Marietta mine in 1939 again was the chief producer in the Park, or Indian Creek, district, the mine was operated by lessees, and the output comprised 257 tons of gold ore and 502 tons of lead ore shipped to smelters At the Blacksmith property 504 tons of gold ore were treated in the 25 ton amalgamation and concentration mill, and 218 tons of gold ore were shipped direct to smelters As in 1938, gold ore from the Speculator mine was treated in a small amalgamation mill Other producing lode mines in the district included the Crosscut, Don L, Independent, Iron Mask, Justice, Little Giant, Mississippi, Monarch, Silver Wave, Sparrow, W A Clark, and West Park & Venezuela properties Poston Bros operated a 2-cubic yard dragline and stationary washer and tested about 1,500 cubic yards of gravel from properties along Indian Creek during October, small-scale sluicing was reported at several placers in the district, including the Whip-poor-will property

CARBON COUNTY

Testing operations at bars along the Clark Fork River near Belfry yielded a small lot of placer gold in 1939

CASCADE COUNTY

Montana district—The total value of the metal output from mines in Cascade County in 1939 increased $139,815 over 1938, owing chiefly to larger output of silver ore from the Big Seven property, the mine and 50-ton flotation mill were operated the entire year by the Montana Silver Queen Mining Co, and the output comprised nearly 600 tons of rich silver concentrates from the mill and nearly 300 tons of crude silver ore shipped to the smelter at East Helena Output of silver ore from the Florence mine also increased Silver ore was treated also in small flotation mills at the Benton and Hartley properties, and a little lead ore was milled by the New London Mining Corporation The remainder of the district output comprised zinc-lead ore shipped to the zinc mill at Anaconda from the Minute Man property, and crude ore shipped to smelters from the Commonwealth, Lucky Strike, Peabody, Silver Belt, and Star mines In addition, a test lot of lead ore was shipped from the Silver Dyke property, however, no work was done at the property by the Silver Dyke Mining Co, and the milling plant, formerly the largest mill in the Neihart area, was dismantled

DEER LODGE COUNTY

Georgetown district—The marked increase in output of gold from mines in the Georgetown district in 1939 was the result of increased output of gold ore from the Southern Cross mine, the property, owned by the Anaconda Copper Mining Co, was operated under lease by the Quarry Mining Co, and shipments of gold ore to the smelter at Anaconda increased to 7,721 tons containing 6,588 ounces of gold Thomas H Sheridan operated the full year at the Holdfast property, but the output of gold ore treated in the 50-ton cyanidation mill decreased slightly to 13,866 tons The Gold Coin Mines Co continued operations at the Gold Coin mine and amalgamation mill throughout the year, and in addition, during the summer months, the cyanidation plant treated old tailings, the combined output of the two plants, however, was considerably less than in 1938 Other producing mines in the district included the Cable, Hub, and Revenue properties

Oro Fino district—Crude ore was shipped to smelters in 1939 from the American, Cashier, Grizzly Bear, and Independence mines

Silver Lake district—A lessee operating the Silver Reef mine 13 miles west of Anaconda shipped 342 tons of silver ore to smelters in 1939 A test lot of silver ore was shipped from the Chloride Silver property

FERGUS COUNTY

Cone Butte district—Small lots of gold ore were shipped to smelters in 1939 from the Golden Aimells and Golden Jack properties

North Moccasin district—The North Moccasin Mines Syndicate continued operations in 1939 at the Barnes-King mine 20 miles north of Lewistown, ore treated in the 150-ton cyanidation mill increased over 1938, and the output of gold increased more than 300 ounces Small lots of placer gold were recovered by sluicing at three properties, most of it came from the Grubstake placer in Iron Gulch

Warm Springs district—All the output from mines in the Warm Springs district in 1939 was crude ore shipped to smelters, it comprised gold ore from the Maginnis group, silver ore from the Argentite, Bay Horse, and Silver Queen mines, and a little lead ore from the Globe property

FLATHEAD COUNTY

Hog Heaven district—The Anaconda Copper Mining Co continued regular operations in 1939 at the Flathead mine south of Kila, the output of silver ore decreased slightly (from 15,797 tons in 1938 to 13,447 tons in 1939), but the output of crude lead ore sent to the East Helena smelter increased from 4,997 to 13,201 tons A little silver ore was shipped to the smelter at Tacoma, Wash, from the Eudora property and from prospects

GALLATIN COUNTY

A test lot of gold ore was sent in 1939 to the East Helena smelter from the Beacon mine, a little lead ore was shipped from the Last Chance mine, and a little gold was recovered by sluicing at the Jewel placer No production in 1938 was reported from mines in Gallatin County

GRANITE COUNTY

Alps district—A car of gold ore from the Alps group south of Clinton was shipped to the East Helena smelter in 1939

Boulder district—Most of the increase in gold from the Boulder district in 1939 resulted from shipments of gold ore from the Gold King & Gold Mountain mine, where the output comprised 354 tons of ore containing 346 ounces of gold Crude ore from the Blue Bird, Brooklyn, Golden Summit, Moonlight, and Sunday mines was shipped to smelters, and ore from the Royal Gold property was treated in a small amalgamation and concentration mill Most of the placer output came from drift mining at the Montana-Tonopah placer

Dunkleberg district.—Small lots of crude ore were shipped to smelters in 1939 from the Murrial, Ruth, and Standby properties.

First Chance district.—The entire output from lode mines in the First Chance (Garnet) district in 1939 was crude gold ore shipped to smelters. Most of it came from leasing operations of the Mitchell-Mussigbrod group (including the Fairview, Fourth of July, Free Coinage, International, Lead King, Red Cloud, Robert Emmett, and San Jose claims). Other producers included the Fluker, Forest, Hobo & Gold Leaf, Grant & Hartford, Laddy Buck, Lynx, Peggy Ann, Sierra, Sunrise, and Tiger mines.

During 1939 the Star Pointer Exploration Co. completed the erection of a 6-cubic foot connected-bucket dredge at the mouth of Bear Creek near Bearmouth; the dredge is electric-powered and equipped with 88 buckets. The new plant was placed in operation October 29 and dredged 349,131 cubic yards of gravel before the end of the year. Small-scale sluicing was reported at the Alma (Cave Gulch), Dixie, Little Dick, and Ten Mile placers.

Flint Creek district.—The total value of the metal output from mines in the Flint Creek (Philipsburg) district in 1939 increased $261,529 over 1938 owing to increased output by the Philipsburg Mining Co. Operations at the Granite-Bimetallic mine and 165-ton flotation plant were suspended in September, after producing 841 tons of rich silver concentrates and 388 tons of crude silver ore that were shipped to smelters. During the summer, however, a plant was built to treat the old tailings dumps near Philipsburg. The tailings were accumulated from the treatment of several hundred thousand tons of Granite-Bimetallic ore in the old chloridizing roast, pan-amalgamation mill. Considerable experimentation preceded construction of the new 300-ton mill, which is essentially a desliming plant using jigs and classifiers. The deslimed, highly siliceous product was shipped to the Tacoma smelter under a special freight and treatment schedule; the mill handled about 43,000 tons of tailings after it was put in operation in August.

The Contact Mines Corporation operated throughout 1939 at the Silver Prince property at Philipsburg; its output comprised 6,716 tons of silver ore shipped to smelters and 6,589 tons of zinc-lead ore sent to the mill at Anaconda, a marked increase over 1938. The Taylor-Knapp Co. (Taylor, Nelson & Knapp, Inc., before June 1939) shipped 2,345 tons of crude silver ore and 1,023 tons of zinc-lead ore from the Two Percent mine during the year. The Trout Mining Division of American Machine & Metals, Inc., shipped 3,567 tons of crude silver ore from the Trout & Algonquin group in 1939, but no zinc-lead ore was produced. The remainder of the output from the Flint Creek district was crude ore shipped to smelters, chiefly from the Headlight, Hobo, and Shannon mines.

Gold Creek district.—Gold ore was shipped to smelters in 1939 from the Clear Grit and Yaller Boy properties, and gold ore was amalgamated at property operated by Schmuck & Whitty. Most of the placer output from the Gold Creek district came from a power shovel and stationary washing plant operated by the Master Mining Co. at the Tibbits & Fowler property; the Triangle and Willow Creek placers also were operated in 1939.

Henderson district.—H. J. Schneider & Bros. operated a ½-cubic yard dragline and stationary washer at the New Deal placer in 1939 and treated about 12,000 cubic yards of gravel. Gold ore was shipped to a smelter from the Sunrise group.

Maxville district.—Siliceous ore was shipped to smelters in 1939 from the Copper Queen, Hoffman (Goldonna), and White Horse properties.

Moose Lake district.—A little gold ore was shipped from the Moose property in 1939, and a test lot of silver ore was shipped from the Mahoney mine.

Red Lion district.—There was a marked decrease in gold from the Red Lion district in 1939, as the output from the Hidden Lake mine was less than in 1938. The mine was operated until May 25 by Hidden Lake Venture, Inc., and later by the Red Lion Mining Co.; the total output comprised 12,612 tons of ore treated by cyanidation in 1939 compared with 24,139 tons in 1938. A small lot of gold ore was shipped to a smelter from the Olympic property.

Rock Creek district.—Nearly 1,700 tons of gold ore were shipped to a smelter in 1939 from the Ella (MacDonald) property, a new producer in the Rock Creek district; siliceous ore was shipped to smelters also from the Mountain Ram, Ozark, and Shakespeare mines. Most of the placer output of the district came from sluicing operations at the Basin and Quartz Gulch properties.

JEFFERSON COUNTY

Amazon district.—Crude ore was shipped to smelters in 1939 from the Adolphus, Amazon & Deadwood, Boulder, Schevers, and Wilbur Silver mines.

Bigfoot district.—Small lots of gold ore were shipped from the Bald Eagle and State properties in 1939.

Boulder district.—Crude ore was shipped in 1939 from several mines near Boulder, including the Baltimore, Ida, Davis-Eureka, Molly McGregor, and Red Eagle properties. A scraper and dry washer were used in treating 7,350 cubic yards of gravel from the Boulder placer.

Cataract district.—The value of the metal output from the Cataract district in 1939 increased $246,508 over 1938 owing to increased output of zinc-lead ore at the Comet property; the mine and flotation mill were operated the entire year by the Basin Montana Tunnel Co., and the ore mined increased from 38,170 to 59,420 tons; small lots of custom ore from several mines in the district were also milled, including ore from the Buckeye & Boston, Crystal, Golconda, and Sylvan mines. In addition to the zinc-lead ore sent to the Comet mill, lessees shipped 1,515 tons of siliceous ore from the Comet mine to smelters. Basin Goldfields, Ltd., operated the Boulder mine from January through September and shipped 1,141 tons of gold ore to the Anaconda smelter. Ore was also shipped to smelters from the Basin Bell, Blue Bird, Congo, Crescent, Dickerson, Mae Lilly, Mayflower, Mantle, Minneapolis, Morning, Saturday Night, and Sirius mines. Gold ore was treated by amalgamation and concentration at the Gray Lead and Hope & Katie (Jib) properties. Small-scale sluicing was reported at several placers near Basin, including the Big Rock, Gold Hill, Nancy, and Park & Anderson properties.

Clancey district.—The output of gold from the Clancey (Prickly Pear Creek, Montana City, etc.) district in 1939 increased 5,526 ounces over 1938, owing to increased output by Winston Bros Co, largest placer producer in Montana, whose new 6-cubic foot floating dredge (put in operation in August 1938) operated during the entire year 1939 and handled 1,787,413 cubic yards of gravel In addition, the company operated the 4-cubic yard dragline and floating washer on Prickly Pear Creek from January until June 24, 1939, when the plant was closed and dismantled after all available ground had been dredged, the dragline plant handled 353,643 cubic yards of gravel The Holmes Gulch Mining Co produced several hundred ounces of gold at a dragline and dry-land washer in Holmes Gulch The Dutton Ranch dragline and dry-land washer operation of O A Barnes produced a little placer gold before the equipment was moved to Marysville in Lewis and Clark County in May A dragline and dry-land washing plant were operated for 20 days in July at the Weber placers on Buffalo Creek The output from lode mines in the Clancey district was crude ore shipped to smelters, chiefly from the Eagle's Nest and Liverpool properties

Colorado district —The Alta property near Wickes in 1939 again was the chief producer in the Colorado district, the property was operated throughout the year by Eathorne & Fox, and the output comprised 48,632 tons of old tailings treated in the 200 ton flotation plant and 218 tons of crude lead ore shipped direct to a smelter A small lot of zinc-lead ore from the Bunker Hill mine was trucked to the Comet mill Silver tailings at the Frohner property were treated in a small jig mill The rest of the district output was crude ore shipped to smelters from the Arogon, Blizzard, Blue Bird, Buckeye, Gregory, Henna, Minah, Minnesota, Mount Washington, Offset, and Pen Yan properties

Elkhorn district —The Center Reef mine was operated during 1939 by lessees, who shipped 159 tons of gold ore to a smelter and treated about 200 tons of ore in a small amalgamation plant A little gold ore from the Klondyke mine was amalgamated Siliceous ore was shipped to smelters from the C & D, Golden Curry, Hard Cash, Little Goldie, Moreau, New Elkhorn, Queen, and Wildcat properties

Golconda district —A lessee shipped small lots of gold ore from the Wonder mine to a smelter in 1939

Homestake district —Small lots of gold ore were shipped to smelters in 1939 from the Golden Valley, Martha, and Sleeping Beauty mines

Lowland district —Kit Carson Placers operated the dragline and dry-land washer equipment on Lowland Creek from April 20 to October 31, 1939, and treated about 630,000 cubic yards of gravel, a marked increase over 1938 A little gold ore from the Infinite property was treated in 1939 in a small amalgamation mill

McClellan Creek district —Small lots of silver ore were shipped in 1939 from the Shaw mine to the East Helena smelter

Mitchell district —E A Studer & Son operated a ½-cubic yard power shovel and stationary washing plant at the Lewis placer in Mitchell Gulch from June to November 1939 and treated about 25,000 cubic yards of gravel The John & Jim group of the Economy Mines Co was operated by lessees in 1939, and 298 tons of gold ore were shipped to a smelter A small lot of gold ore mined at the Haystack Butte mine in 1938 was shipped to a smelter in 1939

Warm Springs district —The value of the metal output from the Warm Springs district decreased from $76,260 in 1938 to $8,374 in 1939 owing to the closing of the mill at the Fleming property of the Newburg Mining & Milling Co late in 1938, the property was idle in 1939, and one small lot of clean-up material was shipped to a smelter The Alhambra Gold Mines, Inc, operated the Katie & Pilot group throughout 1939 and shipped 160 tons of gold ore to the East Helena smelter Gold ore was also shipped to smelters from the Badger, Green Leaf, and Iron King mines

Whitehall district —The value of the metal output from the Whitehall district in 1939 increased $124,293 over 1938 owing to the larger output of gold ore from the Golden Sunlight mine, the property was operated by the A O Smith Corporation and various sublessees, and the output of ore shipped to smelters increased from 3,425 to 9,621 tons Other shipments from the district comprised gold ore from the Claxton, Gold Star, Jack Benny, Lone Eagle, Lucky Hit, Maid of Erin, Morning Glory, New Year, Pay Day, and Sunnyside mines and lead ore from the Blue Bell, Carbonate, Mary Lucile, Midnight, and Surprise properties

Willow Creek district —The Callahan (Deer Horn) mine of the Golden Age Mining Co was operated only a short time in 1939, and the output of gold ore treated in the amalgamation and concentration plant decreased to 310 tons

JUDITH BASIN COUNTY

Barker district —Thorson Bros continued leasing operations in 1939 at property of Glendennin Mines, Inc, in the Barker district, the output comprised 2,659 tons of crude lead ore shipped to a smelter and 54 tons of zinc-lead ore shipped to the mill at Midvale, Utah A test lot of lead ore was shipped from the Champion mine

Running Wolf Creek district —One lot of lead ore from the Morro mine south of Stanford was shipped to the East Helena smelter in 1939

LEWIS AND CLARK COUNTY

Dry Gulch district —The Golden Messenger Corporation operated throughout 1939 at the mine and 130-ton cyanidation plant at York, the mill treated 46,268 tons of ore, which yielded 8,234 ounces of gold and 8,168 ounces of silver in cyanide bullion The rest of the Dry Gulch district output comprised gold ore shipped to a smelter from the Blue Bird mine and small lots of placer dust from small-scale sluicing operations at several properties, including the Franklin, Maude, and Oro placers

Greenhorn district —A lessee operated a 1-cubic yard dragline and dry-land washer in 1939 at the Austin Mountain placer and treated about 10,000 cubic yards of gravel Sluicing was reported at the Con Kelly and Potter placers Small lots of lead ore were shipped from the Humboldt and King Tut lode mines

Heddleston district —Lessees shipped nearly 1,400 tons of siliceous ore to smelters in 1939 from the dump at the Anaconda property at the head of the Blackfoot River 35 miles northwest of Helena

Helena district —The Montana Consolidated Mines Corporation resumed production at the Spring Hill mine in March 1939, after completion of the new 30-ton concentrate-cyaniding plant In 1939 the company treated about 56,000 tons of ore in the 300-ton straight-flotation plant, the flotation concentrates were treated by cyanidation in the new 30-ton plant, and the cyanide tailings were re-treated by flotation to recover lead concentrates. The output of gold from the property decreased more than 800 ounces compared with 1938. Other producing lode mines in the Helena district included the Court House, Eula, Little Wonder, Lockey, Lone Star, Old Dominion, San Juan, Sky, and Whitlatch properties. The Porter Bros. Corporation operated the 6-cubic foot dredge north of Helena throughout the year and treated 1,805,983 cubic yards of gravel, about the same yardage as in 1938, but the output of gold decreased more than 600 ounces. Placer production was reported at six other properties near Helena.

Jefferson Gulch district.—One small lot of gold ore was shipped by a lessee in 1939 from the Wiggins property 8 miles northeast of Finn.

Lake Helena district.—Lessees shipped small lots of gold ore in 1939 from the Lake Shore (Violet Jane) group north of Lake Helena.

Lincoln district.—The Lincoln Metals Co. shipped 40 tons of gold ore from the Margarets property 6 miles northwest of Lincoln in 1939. Most of the placer output of the Lincoln district came from a dragline and dry-land washer operation at the Stonewall property, a small dragline and dry-land washer were operated at the Blue Cloud property, and sluicing was reported at the Bloom & Old Billy Williams, Blue Bird, Harvey, and Liverpool placers.

Marysville district.—The value of the metal output from mines in the Marysville district increased from $211,213 in 1938 to $412,457 in 1939, gold from lode mines increased 1,295 ounces and that from placer mines 3,806 ounces. The gain from placers was chiefly the result of operations by Ralph Davis, Inc., the 3½-cubic yard dragline and floating washer were put in operation April 15, 1939, and handled about 705,000 cubic yards of gravel from the Silver Creek placer during the rest of the year, the property was the largest gold producer at Marysville. O. A. Barnes moved the 1-cubic yard dragline and floating washing plant, previously operated at the Dutton Ranch property near Clancey in Jefferson County, to the Esperanza placer in Empire Gulch in May 1939, the plant handled 10,660 cubic yards of gravel at the Marysville location from August 1 to November 15. Other producing placers near Marysville in 1939 included the Chevallier, Deadman Gulch, and Trus-to-luck properties. The Rex Mining Co., operating the Empire group, again was the largest lode producer at Marysville, the company treated 14,065 tons of gold ore in the 50-ton concentration plant and shipped 459 tons of rich gold-lead concentrates to a smelter. The Martin Mining Co. treated more than 11,000 tons of tailings from the Eck property in a new 120-ton roasting and cyanidation mill. The J. C. Archibald Co. operated its cyanide mill from June 1 to October 31 and treated about 10,000 tons of Bald Butte tailings, in addition, lessees shipped nearly 1,200 tons of crude gold ore from the Bald Butte mine to smelters. Gold ore from the Big Ox and Albert Brown properties was treated by cyanidation. Lessees at the Drumlummon property shipped 1,720 tons of gold ore, a decrease from 2,430 tons in 1938. Crude ore was also shipped to smelters from the Belmont, Big Ox, Climax, Eureka, Excelsior, Mount Pleasant, Carbonate, Penobscot, Piegan-Gloster, Sharnon, and Three M mines.

Missouri River district.—The 6-cubic foot dredge of the Perry-Schroeder Mining Co., which was put in operation in November 1938, operated throughout 1939 and treated 1,459,010 cubic yards of gravel from the Eldorado property 15 miles northeast of Helena. The Duclo Mining Co. operated a dragline and dry-land washer at the Gruell Bar. Production was also reported at the Golden Ring & Sunset, Howe, and Mable (Easterly) placers.

Rimini district.—All the output from lode mines near Rimini in 1939 was crude ore shipped to smelters, most of it was lead ore from the Anna May & Broadway property, shipped by lessees. Other lode producers included the Aurora, Johnny Tunnel, Lone Pine, Peerless Jennie, and Sunset mines. Most of the placer output came from the Black Eagle and Gould properties.

Scratch Gravel district.—Most of the output from the Scratch Gravel district in 1939 was gold ore shipped to smelters from the Ajax and Franklin mines. Crude ore was also shipped from the Gold Crown, Nettie, Silver Coin, and Umatilla properties.

Smelter district.—The fuming plant of the Anaconda Copper Mining Co., treating slag from the lead smelter of the American Smelting & Refining Co. at East Helena, operated throughout 1939, and the output of zinc-lead fume sent to Great Falls was double that in 1938. The value of the metal output increased $795,123 over 1938 and represented most of the gain in Lewis and Clark County.

Stemple district.—The Standard Silver-Lead Mining Co. operated throughout 1939 at the Gould property near Wilborn, 29,053 tons of ore (about the same quantity as in 1938) were treated in the 80-ton cyanidation plant, but the output of gold decreased from 6,265 to 5,652 ounces. Gold ore from the Prize mine was treated by cyanidation by Granite Butte Mines, Inc., and a car of crude ore was shipped to a smelter. The North Gould Mining Co. treated ore from the American Boy group by amalgamation. Small lots of gold ore were shipped to smelters from the Little Dandy and Red Star mines. A little placer gold was recovered by sluicing at the Diamond & Gem placer on Virginia Creek.

LINCOLN COUNTY

Libby district.—The Davis & White Mining Co. operated a 1-cubic yard power shovel and dry-land washing plant from June 1 to October 20, 1939, and treated about 33,000 cubic yards of gravel from the Liberty placer on Libby Creek. Other producing placers near Libby in 1939 included the Big Cherry Creek, Horseshoe, Last Chance, Libby (Brophy), and Logan (Nugget) properties. Gold ore was shipped to a smelter from the Golden West group.

Sylvanite district.—The Morning Glory Mines, Inc., operated the Sylvanite (Keystone) mine in 1939 and treated more than 14,000 tons of gold ore by amalgamation and concentration, the output of gold decreased slightly from that in 1938. Small lots of crude lead ore were shipped to smelters from the Black Diamond and Grouse Mountain properties.

Ural district.—L. C. Curtis & Sons operated a ¾-cubic yard dragline and stationary washing plant during December 1939 and treated about 1,100 cubic yards of gravel from the Pioneer placer on the Kootenai River.

MADISON COUNTY

Cherry Creek (Havana) district—Siliceous ore was shipped to smelters in 1939 from the East Riverside, New Havana, and September Syndicate mines, all on Cherry Creek east of Norris

Norris district—The Revenue mine in the Upper Hot Springs section was the largest producer in the Norris district in 1939, the mine and 80-ton cyanidation mill were operated the entire year by Revenue Mine Developing Group, Inc The new mill, which was placed in operation in October 1938, treated 26,280 tons of ore from the Revenue mine in 1939 (compared with 6,400 tons in 1938), and the output of gold recovered in cyanide bullion increased to 3,997 ounces, in addition, the company shipped 302 tons of gold ore to a smelter, and the total output of gold was 4,180 ounces compared with 1,885 ounces in 1938 Gold produced from the Boaz mine 5 miles east of Norris decreased to 2,511 ounces in 1939, as the output of crude ore shipped to smelters decreased from 1,788 to 775 tons, however, a 60-ton cyanidation plant erected at the mine during 1939 was put in operation late in the year and treated about 1,500 tons of ore before the end of the year Lessees operating the Lexington mine 5 miles southwest of Norris shipped 644 tons of gold ore to a smelter and sent 1,586 tons of ore to the Revenue mill, but the total output of gold decreased more than 500 ounces The rest of the output from lode mines in the district was crude gold ore shipped to smelters from the Arctic, Boyles, Betty May, Billy, Bi-Metallic, Black Chief, Devil's Dream, Eldorado, Emperor, Erma & Lucky Strike, Fortuna, Galena, Gold Bug, Golden Link, Grubstake, Headlight, Josephine, Mascot & Pony, Monitor, Montida, New York Belle, Pulverizer, Rosebud, Santa Christo, Valdez, and Water Lode mines, most of it came from the Billy, Emperor, and Montida mines Homer Wilson operated the 5-cubic foot dredge at the Norwegian placer from March 27 to December 22, 1939, and treated 239,805 cubic yards of gravel, the output of gold increased nearly 500 ounces

Pony (Mineral Hill) district—The Liberty Montana Mines Co operated throughout 1939 at the Mammoth property and treated 28,324 tons of ore in the 120-ton mill compared with 30,862 tons in 1938, but the output of gold (in copper concentrates shipped to a smelter) decreased 1,115 ounces The Montana Southern Mining Co treated 36,317 tons of ore from the Atlantic-Pacific mine in the 100-ton flotation plant and produced 3,164 ounces of gold (almost the same quantity as in 1938) in gold concentrates shipped to a smelter Crude ore was shipped to smelters from the Ben Harrison Fraction, Bozeman, Fraction, Galena, Katie, Keystone-Strawberry, Lone Wolf, McVey, Moonlight, Ridgeway, Whip poor-will, White Pine, Whiterock, and Wolftone mines, most of it was gold ore from the Bozeman mine

Renova (Bone Basin) district—The West Mayflower Mining Co (Anaconda Copper Mining Co) in 1939 again was the largest gold producer in Montana, the company shipped 21,308 tons of gold ore, containing 19,734 ounces of gold and 113,084 ounces of silver, to the Anaconda smelter Gold ore was also shipped to smelters from the Blue Bird, Colorado, Gold Hill, Lakewater, Last Chance Fraction, and Little Nugget properties

Rochester (Rabbit) district—The Lively Mining Co treated 1,411 tons of gold ore in 1939 from the Hidden Treasure mine in a 12-ton amalgamation and concentration mill and shipped 38 tons of crude ore to a smelter The Commonwealth Lead Mining Co shipped 198 tons of lead ore from the Calvin mine to the East Helena smelter Crude ore was also shipped to smelters from the Cooper, Gold Crown, Red Wing, Sandy, Shoemaker, and Struggler mines

Sheridan district—The Sheridan Gold Mining & Milling Co shipped 417 tons of gold ore from the Homestake & Uncle Sam property in 1939 compared with 338 tons in 1938 but the output of gold decreased 340 ounces The output from the Fairview group (operated by Fairview Gold Mines, Inc) comprised 188 tons of gold ore and 33 tons of lead ore, a decrease from 457 tons of gold ore in 1938 Other producing lode mines in the Sheridan district included the Compipius, Cousin Jack, Cousin Jennie, Ella Jay, Gold Point, Goldsmith, Jonquil, Klondike, Lake Shore, Leiter, Lone Tree, Noble, North Star, Red Bird, Red Pine, Sage Hen, Silver Bullion, Sunbeam, and Tamarack mines Most of the placer output came from drift mining at the Cash Boy & Lost Boy property, other producing placers included the Aurum, Blue Bird, Comet, Halloran, and Wisconsin Creek properties

Silver Star district—The value of the metal output of the Silver Star district increased from $231,850 in 1938 to $475,022 in 1939, owing chiefly to increased output of gold from the Broadway (Victoria) property operated by Victoria Mines, Inc The company treated 32,991 tons of ore in the 100-ton cyanide mill (about the same quantity as in 1938), and the output of crude ore shipped direct to smelters increased from 193 to 5,314 tons The Green Campbell Mining Co operated the Green Campbell mine the entire year and treated several thousand tons of ore in the 25-ton amalgamation and flotation plant, the output of gold from the property increased 1,200 ounces The Golden Rod Mining Co continued to ship rich gold ore from the Golden Rod mine, but the output was less than half that in 1938 Gold ore was also shipped to smelters from the Aurora, Broomtree, Edgerton, Iron Rod, Moonlight, Ohio, Silver King, Stansell, and Wheal Clifford properties

Tidal Wave district—Most of the increase in metal output from the Tidal Wave district in 1939 was in gold ore shipped to smelters from the B & H property operated by the Inspiration Gold Mining Co A little gold ore from the Agitator mine was amalgamated Crude ore was shipped to smelters from the Corncracker, Hemmingway (Eleanora), Ella, High Ridge, Last Chance, Keynote, Lone Eagle, Lone Pine, Lottie, Pollinger, Silver Dollar, and Smith properties

Virginia City district—The value of the metal output of the Virginia City district in 1939 increased $89,941 over 1938, as the output of crude ore shipped to smelters increased Lessees operating the Bartlett mine shipped 2,525 tons of gold ore to smelters, a marked increase over 1938, there was also an increase at the Mapleton property, as lessees shipped 3,614 tons of gold-silver ore to smelters Crude ore was also shipped from the Alameda, Apex, Atlas Extension, Bamboo Chief, Bull Frog, Easton Pacific, El Fleda, Hansen, High Up, Homestake, Marietta, Oro Cache, Prospect, Randolph, R B P , St John, Virginia City, and Winnetka properties Gold ore from the Alder Gulch, Mountain Flower, and Valley View properties was treated in small amalgamation mills, and ore from the Easton Pacific mine was treated by flotation Most of the placer output came from the Alder Gulch and Chambers properties

Washington district—All the placer output from the Washington district in 1939 was recovered by the 4½-cubic foot dredge operated by the Gold Creek Mining Co at the Washington Bar property Lessees operating the Missouri-McKee property treated 1,538 tons of gold ore by amalgamation and concentration and shipped 135 tons of gold ore to a smelter Crude ore was also shipped to smelters from the Diamond Cross, Highland Lady, and Snowslide properties

Willow Creek district—The Buena Vista Mining Co shipped a little silver ore from the Silver Mountain property 21 miles south of Alder to the Anaconda smelter in 1939

MEAGHER COUNTY

Atlanta Creek district—A little placer gold was recovered in 1939 from the ground-sluicing of 200 cubic yards of gravel at the Atlanta & Fox property

Beaver Creek district—Most of the output from the Beaver Creek district in 1939 came from operation of a 1-cubic yard power shovel and dry-land washing plant, which treated 29,786 cubic yards of gravel from a placer operated by the T C Mines Other producing placers in the district included the Barton Gulch, Benton, and Watson properties

Castle Mountain district—A little copper ore was shipped in 1939 from the Bell of Castle mine on Hensley Creek, and a little lead ore was shipped from the Great Eastern prospect

Thompson Gulch district—A ¾-cubic yard power shovel and dry-land washer were operated from April 15 to June 15, 1939, and treated 1,050 cubic yards of gravel from the Little Buck property A little placer gold came from the Camp Robber and Cornerstone properties

MINERAL COUNTY

Cedar Creek district—Superior Mines, Inc, operated a 1½-cubic yard power shovel and dry-land washer from April 12 to November 24, 1939, and treated about 90,000 cubic yards of gravel from the Cedar Creek property Other producing placers in 1939 included the Alibi & Hungary, C B & Q, Dakota, Dr Eddy & Nugget, Golden Sunset, Henrietta & Success, Lost Gulch, Lucky Boy, McFarland, Meadow Creek, No Name & Buck Tail, Oregon, Stemwinder, Stockholm, Sunlight, and Windfall properties A car of gold ore was shipped from the Last Chance mine to the smelter at Anaconda

Gold Mountain district—The Gold Mountain Mines, Inc, treated a little gold ore in a 50-ton flotation- and blanket concentration mill in 1939

St Regis district—Small lots of gold ore were shipped to smelters in 1939 from the Gold Chrome and Jack mines

MISSOULA COUNTY

Coloma district—Gold ore from the Dandy and Mountain View properties was treated in small amalgamation and concentration mills in 1939, gold ore was shipped to smelters from the Clemantha, Dandy, Dixie, I X L, Mammoth, Northern Star, and Portia mines

Elk Creek district—The yield of placer gold from the Elk Creek district in 1939 increased 849 ounces over 1938, owing to increased output by the Norman Rogers Mining Co, the company operated a dragline and dry-land washer from April 27 to December 16 and treated about 200,000 cubic yards of gravel A dragline and floating washer were operated at the Piegan placer by W S Grubbs & Co Other producing placers included the Betty Ann, Bob Cat, and Depression properties

Nine Mile district—The Ellis Gold Mines Co operated a 1¼-cubic yard power shovel and dry-land washer from August 23 to December 23, 1939, and treated about 60,000 cubic yards of gravel from the Boyd placer on Eustache Creek Other producing placers in the Nine Mile district included the Barrette, Crysalis, Hard Chance, Imperial, Kennedy Creek, Little Marion, Marion Creek, Oro, and The Bench properties Several cars of gold ore were shipped from the San Martina lode mine

Wallace district—Crude copper ore from the Hidden Treasure mine was shipped to the smelter at Anaconda in 1939, and small lots of lead ore were shipped from the Adalin and Conflict properties

PARK COUNTY

Crevasse district—The Snowshoe Mining Co operated its property from June 25 to October 1, 1939, and treated 1,165 tons of gold ore in the 25-ton amalgamation and concentration mill

Emigrant Creek district—Small scale sluicing was continued in 1939 at placers on Emigrant Creek, most of the output came from the treatment of about 5,000 cubic yards of gravel from the Hefferlin property

New World district—The Irma Mines, Inc, treated several hundred tons of silver ore from the Irma & Republic property by flotation in 1939 and shipped rich silver-lead concentrates A lessee shipped a small lot of gold ore from the Homestake mine

Sheepeater (Jardine) district—The Jardine Mining Co operated throughout 1939 at the Jardine property 6 miles north of Gardiner, 51,130 tons of gold ore were treated in the 185-ton amalgamation and concentration plant, and 111 tons of crude gold ore were shipped to the smelter at Anaconda

PHILLIPS COUNTY

Little Rockies district—The Ruby Gulch Mining Co continued regular operations in 1939 at the Ruby Gulch property at Zortman The output comprised 82,369 tons of ore treated in the 300-ton cyanidation mill and 804 tons of gold ore shipped direct to smelters, the output of gold decreased nearly 600 ounces from 1938 The Little Ben Mining Co treated 46,612 tons of ore from the August group in the 150-ton cyanidation plant compared with 53,581 tons in 1938, the output of gold decreased slightly Most of the output of placer gold from the Little Rockies district came from the Big Slide and Dorothy & Snowball properties

POWELL COUNTY

Big Blackfoot district—The Hilda Gold Mining Co operated the Blackfoot property 10 miles northeast of Helmville from April 5 to November 10, 1939, and shipped 217 tons of gold ore to the East Helena smelter A little gold ore from the Hill Top mine was shipped also to East Helena A test lot of gold ore from the Sweepstake group was amalgamated Most of the placer output came from the Blue Jay and Gold Dust properties

Nigger Hill (Elliston) district—Ore from the Big Dick mine was treated by flotation in 1939 by Big Dick Mines, Inc, and nearly 500 tons of rich gold-lead concentrates were shipped to the East Helena smelter Crude ore was shipped to smelters from the Carbonate Boy, Hattie M & Annie R, Hub Camp, Kierstead, Little Blackfoot Queen, Ontario, Orphan Boy, and Speck mines Most of the placer gold came from sluicing at the Blackfoot and Little Bear properties

Ophir district.—In 1939 lessees hydraulicked about 20,000 cubic yards of gravel at the Levi Davis (Harpole) placer in Ophir Gulch

Pioneer district—In 1939 the 9 cubic foot dredge of the Pioneer Placer Dredging Co was operated from January 1 to August 10 and from October 1 to December 31 and treated 1,114,505 cubic yards of gravel from property on Gold Creek, in 1938 the dredge operated the entire year and treated 1,866,840 cubic yards of gravel The output of gold decreased more than 2,800 ounces Other producing placers in the Pioneer district included the Cold Springs, Gold Star, Irwin, Murray Patent, Nellie B, and Orphan Boy properties Gold ore from the Pike's Peak group was treated in a small amalgamation plant

Race Track district—Small lots of gold ore were shipped to smelters in 1939 from the Amazon and Dark Horse properties on Race Track Creek

Washington Gulch district—The Washington Gulch Leasing Co and other lessees worked intermittently in 1939 at the Eldorado placer in Washington Gulch, about 42,000 cubic yards of gravel were treated in the dragline and dry-land washer during the year Other producing placers in the Washington Gulch district included the Beatrice, Gold Bar, Good Luck, New Deal, Old Shoe, Rietz, Toole (Jefferson Creek Placers), and Whitetail properties Most of the output from lode mines was gold ore from the Grey property Small lots of crude ore were shipped from the Mascot property and from a prospect

Zozell (Emery) district—The entire output of the Zozell district in 1939 was crude ore shipped to smelters, chiefly from the Emery and Bonanza properties, other producers included the Blue Eyed Maggie, Emma Darling, and Hidden Hand properties

RAVALLI COUNTY

Curlew district—There was a marked decrease in the value of the metal output of the Curlew district, as the 100-ton flotation plant, which treated nearly 18,000 tons of old tailings from the Curlew dumps in 1938, was not operated in 1939, the district output in 1939 comprised siliceous ore and lead ore from the Curlew mine shipped to smelters and a small lot of silver ore from the Pleasant View mine

Overwich district—Placer gold and silver were recovered at the Hogue and Hughes Creek properties in 1939 Gold ore from the Baker-Brickley and Washington mines was amalgamated

SANDERS COUNTY

Eagle district—A decrease of $109,271 from 1938 was recorded in the value of the metal output of the Eagle district in 1939, as the output of zinc-lead ore from the Jack Waite mine dropped from 43,390 to 36,028 tons, the property, which extends over the State line into Shoshone County, Idaho, was operated the entire year by the American Smelting & Refining Co The milling ore was treated in the flotation plant at Duthie, Idaho In addition, the company shipped 1,013 tons of rich lead ore in 1939, compared with 1,278 tons in 1938

Revais Creek district—In 1939 the Green Mountain Mining Co shipped 287 tons of rich copper ore from the Drake property on Revais Creek near Dixon to the smelter at Anaconda

Trout Creek district—The Gold Lode Mining Co treated a little ore from the Golden Reef mine in a small amalgamation and concentration mill in 1939 Other producers in the Trout Creek district included the Ambassador, Heidelberg, and Montana Standard properties

Vermillion district—All the output from the Vermillion district in 1939 came from sluicing at the Mammy Lou & Driftwood and Ogoma placers on the Vermillion River

SILVER BOW COUNTY

The total value of the metal output from mines in Silver Bow County in 1939 increased $9,376,536 over 1938, as the output of both copper ore and zinc-lead ore from mines at Butte increased The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1938 and 1939 and the total from 1882 (the first year for which detailed records are available) to the end of 1939

Production of gold, silver, copper lead and zinc in Silver Bow County Mont 1938–39, and total, 1882–1939 in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1938	55	1 642 491	15 147	4 018 192	153 709 857	414 978	1 883 417	$18,300 823
1939	57	2 498 922	22 036	6 114 456	194 533 471	9 415 341	40 032,288	27 677 359
1882–1939		(1)	1 898 219	500 017 146	[2] 5 753 800	[2] 198 247	[2] 1 435 922	2 333 039 695

[1] Figures not available [2] Short tons

Butte or Summit Valley district—The output of copper ore from the Butte mines of the Anaconda Copper Mining Co increased in 1939 owing to increased rate of operations during the last 4 months of the year The output comprised 2,197,863 tons of ore sent to the copper concentrator at Anaconda (compared with 1,561,180 tons in 1938) and 54,075 tons of crude ore sent direct to the smelter (compared with 45,161 tons in 1938), the output of cement copper from the mine-water precipitation plants decreased slightly Operations were resumed at the Butte zinc properties of the company in March 1939 after a shutdown of more than a year, during the remainder of the year 200,036 tons of zinc-lead ore were shipped to the zinc concentrator at Anaconda, a marked increase from the output (2,638 tons) in 1938 The output of recoverable metals (from all classes of materials) increased greatly in 1939—gold increased more than 4,900 ounces, silver more than 2,000,000 ounces, copper nearly 41,000,000 pounds, lead about 8,400,000 pounds, and zinc nearly 36,000,000 pounds Mine development at the copper mines in 1939 comprised 237 feet of shaft sinking, 147,953 feet of drifting, and 8,537 feet of diamond drilling, at the zinc properties 17,775 feet of drifting and 1,939 feet of diamond drilling were reported Mining of zinc-lead ore was resumed in December 1939 at the Emma mine (owned by the Butte Copper & Zinc Co but operated under lease by the Anaconda Copper Mining Co), the mine had been closed since January 1938 The output in 1939 comprised 5,741 tons of zinc-lead ore sent to the mill at Anaconda, in addition, the company produced 6,199 short tons of manganese ore Other producers of zinc-lead ore shipped to mills included the Amy Silversmith, Amy X, Green Copper, Josephine, Magna Charta, Minnie Jane, Wappello, and Wild Pat properties The rest of the output from the Butte district was crude ore shipped to smelters from the Alice, Amy Silversmith, Black Rock, Bluebird, Brophy, Eveline & Twilight, Fayal, Green Copper, Illinois, Josephine, Lavena, Lexington, Magna Charta, Margaret Ann, Pittsmont, Quarter Moon, Sailor's Dream, Sunny Dell, Valdemere, and Wild Pat properties

Divide Creek district —Siliceous ore was shipped to smelters in 1939 from the Gallinipper, Homestead, Margaret, and Queen of the Hills properties

German Gulch district —Most of the output from the German Gulch district in 1939 came from sluicing operations at the Beal placer

Highland district —The Butte Highlands Mining Co operated throughout 1939 at the Highlands property 20 miles southwest of Butte, 19,504 tons of ore were treated in the cyanidation mill, and the output of gold increased to 9,936 ounces from 8,849 ounces in 1938 The rest of the Highland district output comprised crude ore shipped to a smelter from the Highland Queen and North Highland properties and small lots of placer gold from several prospects

Independence district —In 1939 lessees shipped 622 tons of silver ore from the Goldflint mine to the smelter at Anaconda

SWEET GRASS COUNTY

Independence district —A little gold ore from the Daisy property on Basin Creek 55 miles south of Big Timber was treated in a small table-concentration mill in 1939, and a car of crude gold ore was shipped direct to a smelter

TOOLE COUNTY

Gold Butte district —There was a decrease in gold from Toole County in 1939 owing to suspension of operations at Gold Butte Placers late in 1938, the 1939 output came from the Banner, Cummings, Gopher, and Small placers

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By Charles White Merrill and H M Gaylord

SUMMARY OUTLINE

In 1939 copper displaced gold as Nevada's most valuable mineral product, but neither the quantity nor the total value of the copper output reached the mark set in 1937 Gold production exceeded in quantity that in each year since 1916 and in value since 1912 The total value of the gold, silver, copper, lead, and zinc (each calculated in terms of recovered metal) produced in Nevada in 1939—$30,480,870—exceeded that in each year (except 1937) since 1929 Comparing 1939 with 1938, gold increased 22 percent in both quantity and total value, silver decreased 1 percent in quantity but increased 4 percent in value, copper increased 44 percent in quantity and 53 percent in value, lead decreased 9 percent in quantity and 7 percent in value, and zinc decreased 30 percent in quantity and 25 percent in value The total value of the five metals was 30 percent greater than in 1938, of the total, copper comprised 45 percent, gold 42 percent, silver 10 percent, zinc 2 percent, and lead 1 percent

White Pine County continued in 1939 to be the largest contributor to the mineral output of the State, it ranked first in both copper and gold and fourth in silver Esmeralda County was the leading producer of silver and Lincoln County the leading producer of both zinc and lead

All tonnage figures are short tons and "dry weight", that is, they do not include moisture

Yardage figures used in measuring material treated in placer operations are "bank measure", that is, the material is measured in the ground before treatment

The value of metal production herein reported has been calculated at the following prices

Prices of gold silver, copper, lead, and zinc, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35 00	$0 71875	$0 083	$0 040	$0 044
1936	35 00	7745	092	046	050
1937	35 00	7735	121	059	065
1938	35 00	[4] 646+	098	046	048
1939	35 00	[5] 678+	104	047	052

[1] Price under authority of Gold Reserve Act of Jan 31 1934 Treasury legal coinage value of gold from Jan 18 1837 to Jan 31 1934 was $20 67+ ($20 671835) per fine ounce

[2] 1935–37 Yearly average weighted Treasury buying price for newly mined silver 1938–39 Treasury buying price for newly mined silver

[3] Yearly average weighted price of all grades of primary metal sold by producers

[4] [illegible]

Reference No 8

MINES AND MINERAL DEPOSITS (EXCEPT FUELS) CASCADE COUNTY, MONT

By ALMON F ROBERTSON

* * * * * * * * * Information Circular 7589

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L Chapman Secretary
BUREAU OF MINES
James Boyd Director

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February 1951

MINES AND MINERAL DEPOSITS (EXCEPT FUELS) CASCADE COUNTY, MONT

by

Almon F Robertson[1]

CONTENTS

1/ Mining engineer, Bureau of Mines, Minerals Division, Mining Section, Region II

CONTENTS (Cont'd)

CONTENTS (Cont'd)

ILLUSTRATIONS

INTRODUCTION AND SUMMARY

This is one of a series of reports describing investigations within the Missouri River Basin in Montana conducted by mining engineers of the Bureau of Mines, Minerals Division, Region II. The primary purpose of these investigations is to provide basic information to agencies of the Department of Interior and others concerned with the planning of power and other water developments in the basin. This report contains only such factual data as have been authorized for public distribution. Special precautions have been taken not to reveal any information or data that are considered confidential.

The field investigations for this report were made during the summer of 1949. Virtually all known metallic mineral deposits in the county and some nonmetallic (industrial) mineral deposits were investigated Most of the mines and prospects have been inactive for many years. The old underground workings generally are only partly accessible, many are entirely inaccessible Most of the mining claims were located many years ago, and a considerable number were patented. Many claims were abandoned, others were relocated. Names and ownerships often have changed. Because of such conditions, much of the information on most of the mines and prospects necessarily has been obtained from available Federal and State publications, private geologists' and engineers' reports, and from owners and local residents.

Metal mining in Cascade County, Mont., has been confined mainly to the silver-lead-zinc deposits in the Montana (Neihart) and Barker districts in the southeastern part of the county. The Neihart district has yielded by far the greater part of the county's metal output. The mines generally have been operated intermittently, largely because of fluctuating or low silver and base metal prices.

Cascade County was organized in 1887. Search for gold placers led to the discovery in 1879 of rich silver-lead deposits in the Barker-Hughesville area. In 1881, the first silver-lead ore discoveries were made in the area around Neihart.

The mines in the Barker and Neihart areas were developed rapidly. Only high-grade silver ores could be mined profitably at that time. The ores had to be transported by pack train or horse or oxen-drawn wagons to Fort Benton, and from there were carried on Missouri River steamboats to Kansas City, St. Louis, and elsewhere for ocean shipment to Swansea, Wales, for smelting. Smelters soon were erected at Hughesville and Barker (Clendenin), but much of the high-grade ore and bullion produced during 1883 and 1884 was shipped by river to Omaha. Great Falls, Mont., was founded in 1882. Concentrating mills and smelters soon were erected at various localities. A branch line of the Great Northern Railroad reached Barker and Neihart in 1891. Mining generally was suspended during the years of low silver prices.

From 1889 to 1948, inclusive, the mines in Cascade County produced gold, silver, copper, lead, and zinc valued at $20,093,595 in terms of recovered metals. Records are not available for the years prior to 1889, but production is known to have had considerable value. Gypsum was mined and processed in the county from 1908 to 1915. Some limestone was mined years ago for smelter flux and for use in a sugar factory. Fire clay is being mined near Armington

ACKNOWLEDGMENTS

Statistical information on mineral production was supplied by the Economics and Statistics Division, Bureau of Mines, Salt Lake City, Utah. Climatological data were supplied by the U. S. Weather Bureau, Helena, Mont.

Information regarding smelter schedules, power schedules, and freight rates, as related to the mineral industry within Cascade County, was provided by the Anaconda Copper Mining Co., the American Smelting and Refining Co., the Montana Power Co., the Chicago, Milwaukee, St. Paul, & Pacific Railroad, and the Great Northern Railroad.

Special acknowledgment is given the many claim owners and prospectors for their kind cooperation during the field investigations and for providing information and maps of various areas and properties.

Much valuable information was obtained from reports and publications of the U. S. Geological Survey, the U. S. Bureau of Mines, the Montana Bureau of Mines and Geology, the State of Montana, and other sources. Acknowledgment of the source of such information is noted in the text either directly or by a number in parentheses that refers to the list of references at the end of this report.

LOCATION AND ACCESSIBILITY

Cascade County is in north-central Montana. The area of the county is 3,411 square miles. It is situated geographically between the 111th and 112th meridians, west longitude, and between the 47th and 48th parallels, north latitude. Population, according to the 1940 census, was 41,999. At that time Great Falls, the county seat, had a population of 29,928 within the corporate limits, or 33,332 including suburban inhabitants. Based upon the Polk Directory returns of 1949, the population of Great Falls and its environs was estimated to be 43,666. Great Falls is on the Missouri River in the north-central part of the county, it is the principal supply center and the site of the Anaconda Copper Mining Co.'s Great Falls reduction works and zinc plant. Metal mining has been confined mainly to the mountainous area in the southeastern part of the county (fig. 1).

The Great Northern Railroad and the Chicago, Milwaukee, St. Paul, & Pacific Railroad serve the county. Branch lines of the Great Northern Railroad extend to Great Falls from Shelby, 99 miles to the north, and from

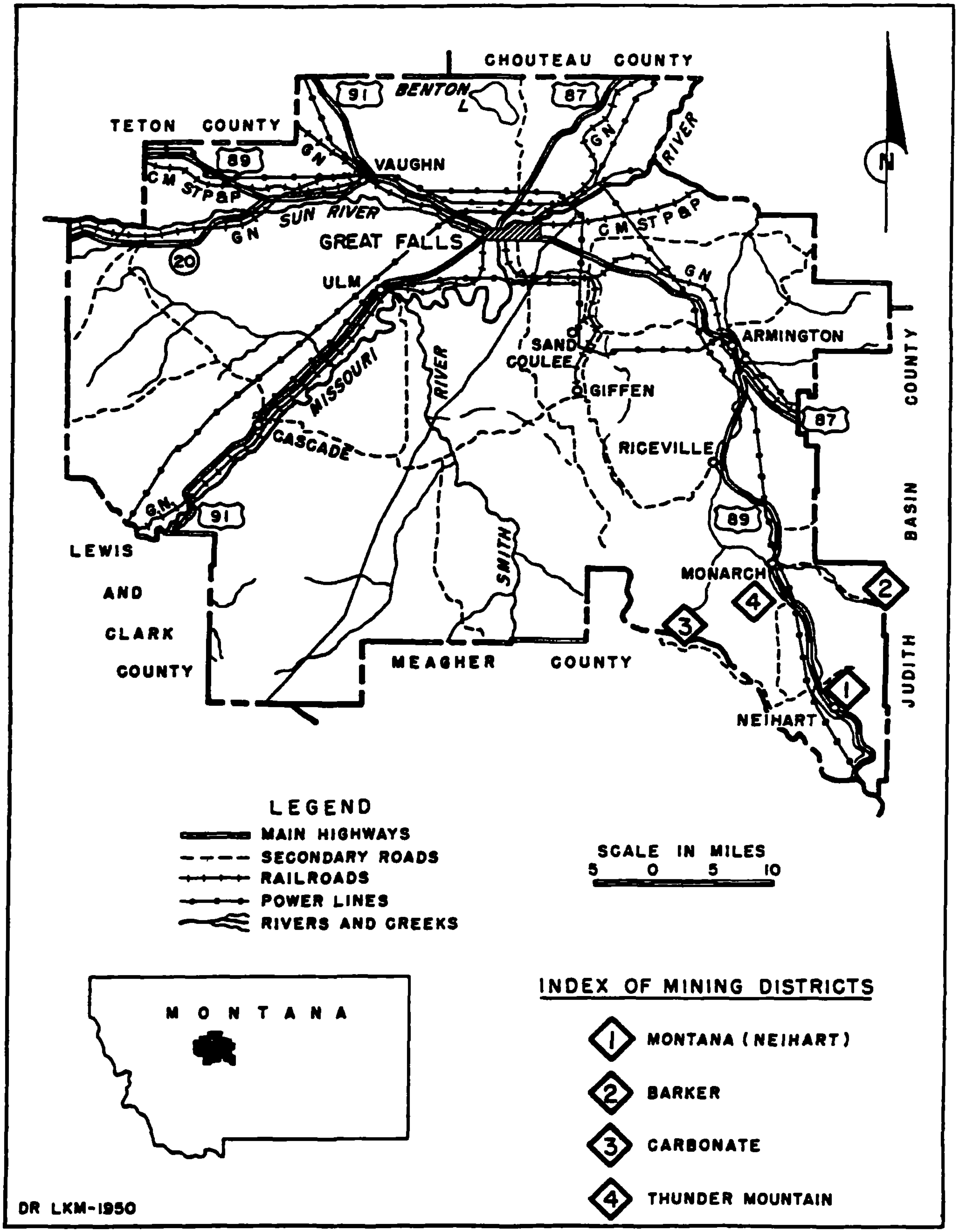


Figure 1 - Index map, Cascade County, Mont

Havre, 123 miles to the northeast, both points being on the main line A branch line from Great Falls connects with Helena and Butte, respectively 98 and 170 miles distant to the southwest. Other branch lines extend from Great Falls to August a in Lewis and Clark County, 54 miles to the west, and to Pendroy in Teton County, 77 miles to the northwest. A branch from Great Falls connects at Billings, 235 miles to the southeast, with the Northern Pacific and Chicago, Burlington, & Quincy Railroads. The Chicago, Milwaukee, St. Paul, & Pacific Railroad branch line from Harlowton extends 199 miles to Great Falls and on to Agawam in Teton County, 66 miles farther to the northwest, it crosses the northern part of Cascade County.

A branch of the Great Northern Railroad formerly was operated in the southeastern part of the county from Armington, through Monarch, to Neihart. From Monarch, a privately owned spur track served the Barker mining district in Judith Basin County. This branch line and the spur from Monarch to Barker were removed during World War II.

U. S. Highway 91 crosses the county in a north-south direction, it connects Great Falls with Shelby and the province of Alberta to the north and with Helena and Butte to the southwest. U. S. Highway 89 passes through Great Falls, it leads northwest to Glacier Park and southeast to Armington, Neihart, and White Sulphur Springs. U. S. Highway 87 extends east from Great Falls to Lewistown, thence south to Roundup and Billings. U S. Highway 89 and graveled county roads leading therefrom provide access to most of the mines and prospects in the vicinity of Barker and Neihart. Unimproved roads and Forest Service trails lead to the more isolated properties.

Silver-lead ores and concentrates produced in the Neihart and Barker areas, formerly shipped by rail to the smelters, now are trucked directly to the smelter at East Helena. Zinc concentrates are trucked to Armington and from there are shipped by rail to the zinc plant at Great Falls The distance by road and highway from Barker and Neihart to Armington is 36 miles. It is 160 miles from Neihart to the Smelter at East Helena via Armington and Great Falls. From Neihart by U S. Highway 89 to White Sulphur Springs, State Highway 6 to Townsend, and U. S Highway 10 N to East Helena the distance is 118 miles. The distance from Barker by this route is 144 miles. Although this route is shorter, it is used infrequently because of the steep grades on King's Hill south of Neihart.

Distance in miles by railroad from Armington to the smelting and refining plants in Montana via the Great Northern Railroad are as follows

Shipping point	American Smelting & Refining Co., East Helena	Anaconda Copper Mining Co , Washoe Sampler, Butte	Anaconda Copper Mining Co. zinc plant, Great Falls
Armington	132	199	31

The location of the principal mining districts and their relation to highways, railroads, and population centers are shown on figure 1.

CLIMATE

The climate in Cascade County varies markedly at different localities during all seasons of the year. It generally is semiarid. Summer temperatures usually are moderate. In July and August temperatures may exceed 100° in the Missouri River Valley. During the same months temperatures in the Little Belt Mountains may range from below freezing to 90°. Heavy snowstorms may occur in the mountains, whereas at lower altitudes fine warm weather may prevail. The winters are long and severe, though tempered for short periods by warm chinook winds, temperatures may range from above freezing to more than 40° below zero.

Precipitation varies considerably in different parts of the county. Severe thunderstorms are common in the mountains during the summer. Maximum precipitation usually occurs during May and June and minimum during December and January. Climatological data recorded at stations in and adjacent to Cascade County, Mont., are given in tables 1 and 2. They were compiled from data provided by the U. S. Weather Bureau, Helena, Mont.

TABLE 1. - Average monthly and annual precipitation1/ and snowfall, in inches, at following U. S. Weather Bureau Stations in Cascade County, Mont.

Station ... . Elevation, feet....	Adel 5,200		Great Falls (airport)2/ 3,657		Kings Hill 7,450	
	Precipitation1/	Snowfall	Precipitation1/	Snowfall	Precipitation1/	Snowfall
Length of record, years.....	47	31	54	37	8	8
January...........	1.30	15.0	0.61	8.8	1.98	31 4
February...	1.32	14.9	.57	6.5	2.27	42 5
March...	1.84	19.2	.86	7.7	1 93	31.8
April.............	2.38	15.5	1.15	4 4	2.09	24 8
May........... ...	3.77	7.7	2.24	.9	3 11	9.0
June..	4.24	0.6	3.13	.T	4.56	8.6
July........	2.06	.0	1.51	.0	1.94	0.0-0 2
August.......	1.84	.1	1.15	.T	1.97	0.0-0.2
September.........	2.43	4.3	1.44	.8	2.11	9.4
October...........	2.01	16.0	.86	2.2	1.98	18.2
November..........	1.14	11.6	.68	6.7	2.21	35.6
December..........	1.35	16.1	.65	7.3	2.40	39.1
Annual average ..	25.68	121.0	14.85	45.3	28 55	250.8

1/ Includes snowfall converted to water.
2/ Four miles southwest of Great Falls.

TABLE 2. - Average temperature data, in degrees Fahrenheit, at following U S. Weather Bureau Stations in Cascade County, Mont

Station	Adel	Great Falls	Kings Hill
Elevation, feet	5,200	3,657	7,450
Length of reocrd, years	31	39	7
Annual average	40.3	45.4	35 4
Mean maximum			
January	32.0	33.3	26.0
July	76.4	83.7	71.8
Annual	53.6	57.6	46.9
Mean minimum			
January	9.6	12.4	9.4
July	44.7	53.7	43.2
Annual	27.0	33.3	24.4
Highest			
January	58.0	86.0	-
July	97.0	103.0	-
Annual	98.0	106.0	90.0
Lowest			
January	-45.0	-44.0	-
July	25.0	35.0	-
Annual	-51.0	-44.0	-42.0
Latest date 32° or lower in spring	May 27 to July 12 1/	April 9 to June 8	June 8 to June 23 1/
Earliest date 32° or lower in fall	July 17 to September 21 1/	September 6 to October 14	August 17 to October 6 1/

1/ Below freezing temperature recorded in all months during some years.

TOPOGRAPHY

The northern part of Cascade County is characterized by wide, gently sloping benches that extend northward from the Missouri River. At the west, the foothills of the main range of the Rocky Mountains extend in irregular spurs toward the plains Along the east boundary the Highwood Mountains rise abruptly above the rolling benches, which slope northward toward the Missouri River from the Little Belt Mountains. The southeastern part of the county includes a part of a jumbled mass of mountains that extend northward from the main Little Belt Mountain Range. The southern boundary of the county follows the crest of the Little Belt Mountains in a northwesterly direction. Steep ridges extending northeastward from the Big Belt Mountains and the rolling hills and gently sloping benches west of the junction of Smith River with the Missouri River form the southwestern part of the country.

Altitudes range from 2,800 feet above sea level at the Missouri River between Cascade and Chouteau Counties to a maximum of 8,473 feet on Long Baldy Mountain east of Neihart. The average altitude is between 3,000 and 4,000 feet.

The Highwood Mountains northeast of Armington cover an area of about 80 square miles. They have been deeply eroded, but the peaks and ridges are rounded. Slopes generally are gradual. Highwood Peak, the highest in the range, has an altitude of 7,600 feet, or about 3,300 feet higher than the surrounding plain. This peak and most of the others in this mountain mass are in Chouteau and Judith Basin Counties, which adjoin Cascade County on the northeast and east.

The Little Belt Mountains at the southern border of the county extend in a northwest-southeast direction for about 45 miles, thence eastward for about 30 miles. The northwestern part of the range averages about 25 miles in width. The eastern part narrows to a point near Judith Gap in Wheatland County North of the divide, the range contains a number of isolated mountains that rise above their surrounding areas. Several of these mountains exceed 8,000 feet in altitude. The ridges are rounded, but deep canyons have been eroded by numerous streams. Many of these spring-fed streams have a continuous year-round flow, others are intermittent as their waters disappear in the sediments and surface debris near the base of the mountains.

The Missouri River flows northeastward across the central part of Cascade County. The southern and eastern parts of the county are drained by northward-flowing steams, the western and northern parts by the eastward flowing Sun River and its tributaries and by smaller streams that flow southward toward the Missouri River.

The northern slopes of the mountains above 6,000 feet in altitude generally are heavily timbered. Most of the forest is second growth, but in the more remote localities larger timber suitable for mining purposes can be found.

The wide valleys and gently sloping benches in the central and northern parts of the county are very fertile. Stock raising and farming are the principal industries. Near Great Falls the Missouri River has cut a deep channel through the surface soils and gravels of the valley and into the underlying sedimentary formations. In this locality the river has a fall of 365 feet in a distance of about 8 miles. Utilization of the energy of these falling waters by the construction of dams and power houses has provided electric energy for many industries in the county and western Montana.

HISTORY

Cascade County is reported to have been visited by white men about 1744, when de La Verendrye, a French explorer, turned south from Canada, crossed into what is now North Dakota, and followed up the Missouri River to near what is now Great Falls, Mont. (16). In June 1805, Lewis and Clark followed the Missouri River on their journey across the northwest to the Pacific coast. In the following years the region was visited frequently by many adventurers, fur trappers, and explorers, who followed the river to the head of navigation below the Great Falls. In 1846 a trading post was established at Fort Benton by Captain John Mullen. Travel through the region increased with the influx of settlers, expecially after the discovery of gold at Virginia City, Bannock, Last Chance Gulch, Confederate Gulch, and other localities in Montana (16) (11).

Gold placers were discovered about 1863 in Yogo Gulch at the eastern end of the Little Belt Mountains, an area later included in Judith Basin County, but the prospectors were driven out by hostile Indians. About 1879 the placers at Yogo Gulch were "rediscovered." They did not prove to be profitable, however, and by 1880 most of the claims were abandoned. (28).

The silver-lead deposits near Barker, now mainly in Judith Basin County, were discovered in October 1879 by Buck Barker and Pat Hughes (13) who had left Yogo Gulch in search of placer deposits. The first claims in the Neihart area were located by J. L. Neihart, J. C. O'Brien, James Anderson, S. R. Hartley, and Michael Powers during the summer of 1881. (13).

Mines in the Neihart and Barker areas were developed rapidly, and much ore was produced during the next few years. Only the high-grade ore could be mined at a profit. It had to be transported to Fort Benton by pack animals or by wagons drawn by horses or oxen and then shipped by river steamers to Kansas City, St. Louis, or New Orleans, from there it was sent to Swansea, Wales, for smelting. To avoid these high transportation costs, smelters were constructed at Hughesville and at Barker, which at that time was called Clendennin. The smelter at Hughesville did not operate long because it was not equipped with satisfactory refractory lining. The smelter at Clendennin, built by Colonel George Clendennin in 1881, had a 40-ton water-jacketed furnace. It was operated until 1883 and produced bullion valued at $375,000 (9). Some of the high-grade ore and bullion produced during 1883 and 1884 was shipped via the Missouri River to Omaha for smelting. Some of these ore shipments are reported to have netted the mine owners $200 a ton after deducting $100 a ton for freight and treatment charges (29).

Great Falls was founded in 1882 by Paris Gibson with the assistance of James J. Hill and others. A smelter was constructed near Giant Springs below Great Falls by the United Smelting & Refining Co. This smelter was operated for several years and treated many thousand tons of silver-lead ore from the Neihart and Barker areas. During the 1880's, some ore was hauled to other smelters at Wickes, Toston, and Argenta, Mont.

The Hudson Mining Co. constructed a concentrator and smelter at Neihart in 1885-86. About 1,000 tons of concentrates and bullion valued at $50,000 to $60,000 were produced before the company ceased operating in 1887 (29). From 1887 to 1891 little mining was done at Neihart or Barker. In 1888 two new smelters had been constructed in Montana. One of these was built near Great Falls under auspices of the Saint Paul, Indianapolis, and Manitoba Railway, the other was built at Helena by the Helena & Livingston Co. under the auspices of the Northern Pacific Railroad (22-1887). Completion of the branch line of the Great Northern Railroad to Neihart in 1891 provided transportation to the new smelters at reasonable rates. Mining increased in the Neihart and Barker areas (17). Several properties were developed and became steady producers.

The population of Neihart in 1892 was estimated at 2,500. Demonitization of silver in that year caused the price of silver to drop from about $1 to about $0.64 an ounce. The price of lead also was low. Mining declined, from 1895 to 1905 only a few of the exceptionally high-grade mines could be operated profitably. Between 1905 and 1915 operation at most of the mines was intermittent. Two small concentrators were built during this time, but as only a bulk concentrate high in zinc was produced, there was little if any advantage over direct shipment of sorted ore to the smelters. A small cyanide plant was constructed at one of the mines on Snow Creek. This plant was operated for only a short time, only one small bar of silver bullion was produced. In 1915 the price of silver began to rise. Steady base metal prices and the development of the selective flotation process for the concentration of low-grade ores created new interest in the Neihart and Barker areas. Many of the old mines were reopened, several of the larger mines expanded their operations, several selective flotation plants ere constructed. Having reached a peak in 1919, silver prices again declined. A few of the larger mines, however, continued to operate at a high rate of production. This was possible because the revenue received for lead, copper, and zinc concentrates compensated to some extent for the smaller returns for silver. Most of rich near-surface silver ores were depleted. Ore mined at greater depths contained less silver and more zinc. In 1930 the price of silver declined to less than 30 cents an ounce, and soon all of the mines were forced to close. Until 1935, most of the mines in the Neihart and Barker areas were inactive.

In 1934 the price of silver was established at 64.8 + cents per fine ounce. The price was raised to 71.875 cents in 1935. The increased price revived interest in the old mines, and many were reopened. During World War II and until 1949, prices of silver, lead, and zinc held at comparatively high levels. The sudden drop in the prices of lead and zinc in the spring of 1949, together with higher mining costs, was responsible mainly for the complete shut-down of all mining and milling operations in these areas.

PRODUCTION

Table 3 shows a production of gold, wilver, copper, lead, and zinc in Cascade County from 1889 to 1948, inclusive, in terms of recovered metals valued at $20,093,595. The table is a compilation of data provided by the Economics and Statistics Division of the Bureau of Mines, Salt Lake City, Utah (14).

Before 1887, when Cascade County was formed from parts of Choutoau and Meagher Counties, the Montana (Neihart) and Barker mining districts were in Meagher County. Cascade County boundaries were again changed in 1920, when Judith Basin County was created. This placed most of the mining claims in the Barker mining district in Judith Basin County. A few of these claims, however, including several from which a considerable tonnage of lead-silver ore had been mined, remain in Cascade County.

Between 1880 or 1881 (when the ore deposits in the Barker and Neihart areas were discovered) and 1889, few production records were kept. During these years many mines in the two areas were mined intensively, large

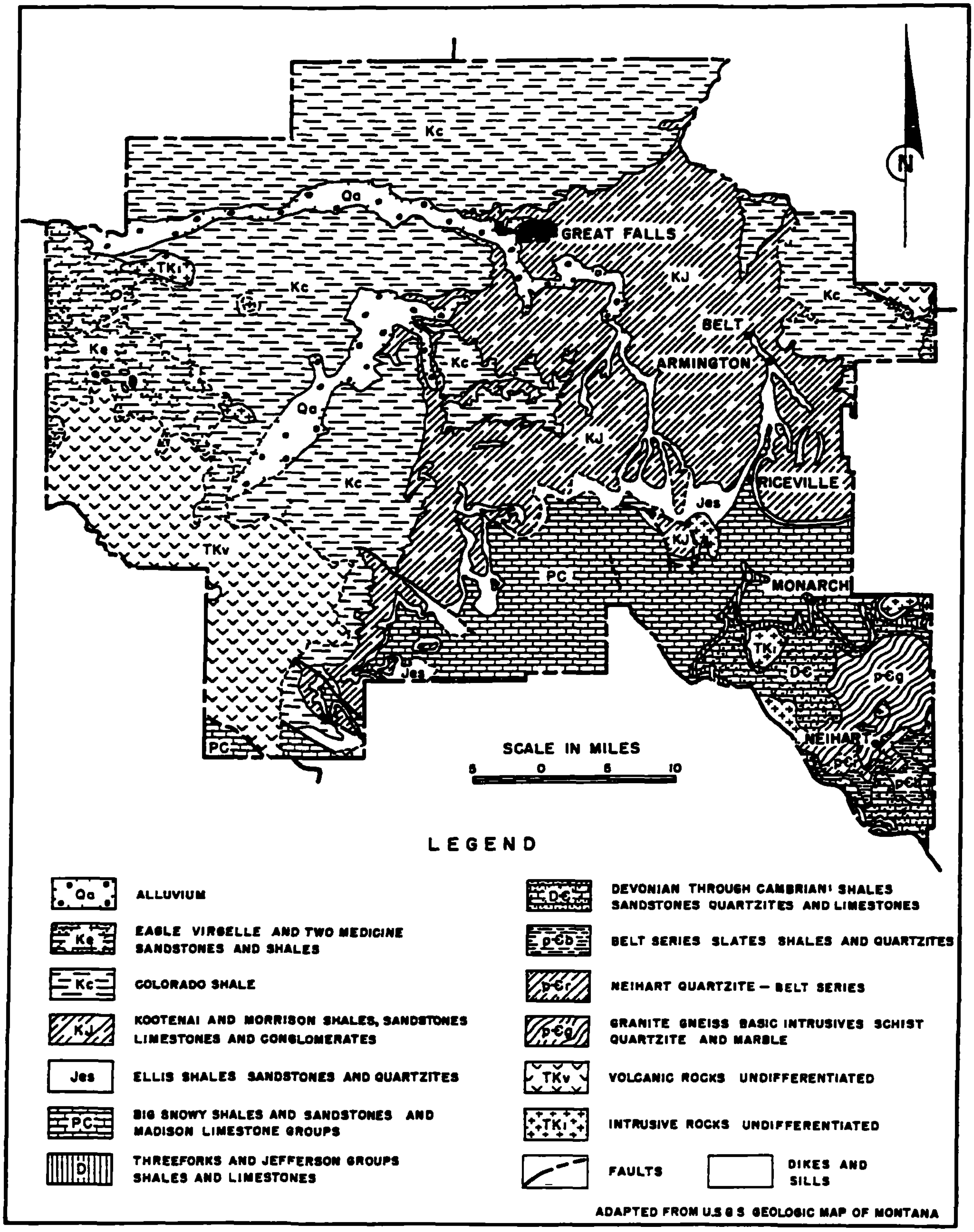


Figure 2 - Generalized geologic map of Cascade County, Mont

quantities of rich lead-silver ores were produced. No production records for 1899 and 1900 are available, though it is known a number of mines were operated during those years. It is apparent, therefore, that the total metal production of Cascade County has been considerably larger than that indicated by the totals shown in table 3.

Zinc in ores or concentrates was not recovered by the smelters during the early years, it was lost mainly in the smelter slags. It was not paid for but was penalized at a high rate. The electrolytic zinc plant of the Anaconda Copper Mining Co. at Great Falls was not constructed until 1916. In 1927, a slag-fuming plant was constructed by the Anaconda Copper Mining Co. near the lead smelter of the American Smelting & Refining Co. at East Helena. Since then, zinc has been recovered in this plant from the molten lead smelter slags. A large quantity of old slag has been treated also, and much zinc lost in earlier operations has been recovered.

Before 1925 the amount of zinc recovered from ores mined in Cascade County, as indicated in table 3, was very small. However, the total quantity of the zinc contained in the ores shipped, as indicated by the amount of zinc recovered from 1940 to 1948, inclusive, apparently was large.

No other metals are reported to have been produced in Cascade County except those recorded in table 3. At one time limestone was mined for use as flux at the Great Falls smelter. Gypsum formerly was mined and processed in the county. Fire clay is mined near Armington. No production data on nonmetallic minerals are available.

GEOLOGY-GENERAL

Rock formations ranging from Archean gneisses and schists to Pleistocene conglomerates are exposed in Cascade County (fig. 2). In the central and northern parts, the soil, gravels, and glacial till are underlain with nearly flat-lying Cretaceous sedimentary rocks. Around the Highwood Mountains, near the east side of the county, these sedimentary rocks were relatively undisturbed in attitude by the volcanoes that broke through these earlier sedimentary formations.

The Highwood Mountains consist of various rocks of volcanic origin peculiar to this locality. The central cores of these mountains are composed of syenite, monzonite, and shonkinite. Surrounding these rocks and in places covering their eroded surfaces are extensive deposits of basltic breccias, lavas, and scoria. Numerous basaltic sheets and dikes radiate in all directions from the old volcanoes (27). No metallic mineral deposits are known to occur in the Highwood Mountains.

TABLE 3 - Mine production of gold, silver, copper, lead, and zinc in Cascade County 1/, Mont , 1889-1948, in terms of recovered metals

Year	Mines producing 2/	Ore sold or treated short tons	Gold		Silver		Copper		Lead		Zinc		Total value
			Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1889	3/	3/	5 609 00	$115 948	603 931	$567 695	-	-	-	-	-	-	$683 643
1890	do	do	3 26	67	-	-	-	-	-	-	-	-	67
1891	-	-	-	-	-	-	-	-	-	-	-	-	-
1892	3/	3/	27 11	560	1	1	-	-	-	-	-	-	561
1893	do	do	33 03	683	2	2	-	-	-	-	-	-	685
1894	do	do	61 38	1 269	3	3	-	-	-	-	-	-	1 272
1895	do	do	34 91	722	9	12	-	-	-	-	-	-	734
1896	do	do	34 49	713	2	2	-	-	-	-	-	-	715
1897	do	do	490 05	10 130	385 845	498 870	-	-	1 338 836	$160 660	-	-	669 660
1898	do	do	1 008 56	20 849	430,398	556 474	-	-	3,729 158	462,416	-	-	1 039,739
1899-1900	do	do	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
1901	2	3 113	-	-	246,738	219 008	-	-	-	-	-	-	219 008
1902	6	4 281	681 00	13 620	487 793	238 777	-	-	695 781	23 916	-	-	276,313
1903	4	2 257	30 00	600	168 760	75 787	-	-	468,216	9 111	-	-	85 498
1904	4	2 271	6 25	129	204 574	117,059	-	-	718 308	30 952	-	-	148 140
1905	6	11,951	183 [illegible]	3 787	415 708	251 088	-	-	747 686	35 141	-	-	290 016
1906	14	8 393	324 46	6 707	294 556	197,352	360	$70	569 046	32 436	-	-	236 565
1907	17	3 897	575 35	11,906	197 124	130,102	-	-	355,720	18,853	-	-	160 861
1908	15	1,103	226 78	4 688	94 021	49,531	6 352	839	180,320	7 574	-	-	62 632
1909	9	1 956	93 96	1 942	101 117	52 581	540	70	109 589	4 712	-	-	59,305
1910	12	1 381	104 97	2 170	57 060	30 812	18 415	2 339	298 489	13 134	-	-	48 455
1911	10	2 962	134 19	2 774	99 825	52 907	5 314	664	861 613	38 773	-	-	95 118
1912	14	7 406	195 29	4 037	138 608	85 244	6 379	1 053	2,259,494	101 677	-	-	192 011
1913	16 4/	13 600	262 82	5 433	292 266	176,529	3 717	576	3 179 501	139,898	4 50[illegible]	$253	322,689
1914	12	7 292	441 71	9 131	144 473	79 894	[illegible] 621	482	1 583,041	61 739	[illegible] 870	95	151 341
1915	15 4/	1 789	592 50	12 248	154 488	78,325	4 365	764	526 751	24,757	-	-	116 094
1916	17	2 005	316 02	6 533	98 651	64 912	3 916	963	635 169	43,827	19 106	2 560	118 795
1917	34	6 791	220 35	4 555	204 178	168 243	1 023	279	1 295 063	111 375	-	-	284 452
1918	22	4 615	363 97	7 524	246 523	246 523	-	-	1 100 08	76 106	-	-	332 153
1919	23	16 903	729 83	15 087	518 946	581,220	6 305	1 173	2 860 27	151 595	-	-	749,075
1920	25	22 535	839 06	17 345	510 832	556 807	6 474	1 191	3 127 146	250,172	-	-	825 515
1921	17	14 528	390 19	8 066	512 092	512,092	2 098	271	1,498 28	67 427	-	-	587 856
1922	17 4/	19 713	367 41 5/	7 613	586,967	586 967	56	8	1,550,876	85 298	-	-	679,886
1923	17	110 939	539 70	11 157	555 357	435 393	582 918	85 689	1,824 454	127 712	5 075	345	680 296
1924	10	163 444	772 45	15 968	637 816	427 337	1 186 694	155 457	2,481 751	198 540	8 264	537	797 839
1925	10	193 289	718 85	14 860	639,497	443 811	1 342 458	190,629	3 705 994	322 421	10[illegible] 960	7 749	979 470
1926	13	251 891	484 70	10 020	809 937	505 401	1 717 705	240 479	5,057,58[illegible]	404,604	656 88[illegible]	49 266	1 209 770
1927	8	279 544	372 39	7 698	702 341	398,227	1 605 579	210,331	4 153,35[illegible]	26[illegible] 661	1 275 491	81 631	959 548
1928	8	199 945	356 00	7 359	512 440	299 777	768 971	110 732	2 863 13[illegible]	166 062	766 926	46,776	630 706
1929	5	48 746	82 42	1 704	137 503	83 949	399,911	70 384	985 22[illegible]	62 069	10[illegible] 156	7 204	225 310
1930	1	355	7 80	161	8 920	3,434	19,090	2 482	147 255	7 363	4,022	193	1[illegible] 633
1931	5	126	103 00	2 134	12 481	3 619	5,839	531	64 43[illegible]	2 384	-	-	8 668
1932	4	59	65 00	1 343	6 330	1,785	1 825	115	15 76	473	-	-	3 716
1933	3	51	3 00	63	360	126	734	47	8 56[illegible]	317	8 071	339	892
1934	8	665	25 00	886	14 720	9,516	450	36	40 91[illegible]	1,514	-	-	11 952
1935	18	3 614	31 00	1 078	29 632	21,298	2 398	199	63 62[illegible]	2 545	3 773	166	25 286
1936	9	64 856	441 00	1[illegible] 428	139,858	108,320	1,[illegible]85	109	219,32[illegible]	10 089	-	-	133 946
1937	13	44 618	984 00	34 440	239 660	185 377	2 000	242	435 000	25,665	-	-	245 724
1938	9	37 033	1 197 00	41 895	305,893	197 749	3 786	371	424,065	19 507	-	-	259,522
1939	11	44 432	2 078 00	72 730	438 374	297,563	9 250	962	586,425	27,562	10 000	520	399 337
1940	14	74 594	3 569 00	124 915	730 959	519 793	22,000	2 486	1 910 700	95 535	1 425,000	89 775	832 504
1941	10	103 288	4 839 00	169 365	1 104 047	785 100	46 000	5 428	3 201,000	182,457	2 948 000	221 100	1 363 450
1942	11	77 208	2 765 00	96 775	730,620	519 552	32 000	3 872	2,067 000	138 489	1 018 700	94 739	853 427
1943	11 4/	41 267	501 00	17 535	197 730	140 608	9 700	1 261	1,067 600	80 070	529,500	57 186	296,660
1944	7	48 274	384 00	13 440	93 915	66,784	18 800	2 538	1,223 80	97,904	1 399 500	193 743	374 409
1945	6	35 141	163 00	5 705	75 285	53 536	8 800	1 188	949,00	81 614	1 906 000	219,259	361 302
1946	6	22 226	129 00	4 515	122 286	98,807	7 000	1,134	743,000	80,987	915,500	112 057	297,500
1947	5	35 932	231 00	8 085	191 632	173 427	13,800	2 898	1,164 000	167 616	1,209 200	146 313	498,339
1948	5	10,007	88 00	3 080	44,328	40,119	4,700	1,020	431,800	77,292	526,500	70,024	191,535
Totals		2 052 286	35 311 99	$979 [illegible]75	15 697 412	$12 015 227	7 882,328	$1 101 362	65,523 298	$4,396 001	15 [illegible]56 496	$1 401 830	$20 093 595

1/ Cascade County created September 12 1887 Table includes data from 1889-1920 for territory that became Judith Basin County in December 1920
2/ Lode mines only except where otherwise noted
3/ Data not available
4/ Includes one placer operation
5/ Includes 0 87 ounce of placer gold

The Little Belt Mountains are the eroded remains of a broad domal uplift caused by laccolithic intrustions (28) The sedimentary beds at the summits usually lie flat or are gently inclined (27) Around the northern borders of these mountains the beds are more steeply inclined toward the north and west, decreasing in dip with distance Many local isolated domes extend in a northerly direction from the main domal uplift Several of these structures occur in the southeastern part of Cascade County and in the western part of Judith Basin County They form the irregular more prominent mountain peeks and high ridges which are separated by troughs along which erosion has exposed younger rocks surrounded by older ones The summits of some of these outlying structures are capped with horizontal beds of sedimentary rocks The sedimentary rocks have been removed completely from some domal structures, exposing the older pre-Beltian formations (fig 2)

Belt Creek and its tributaries in the area around Neihart have cut into the surrounding plateau to a depth of about 2,000 feet From Belt Creek the valley walls rise steeply to gently rolling surfaces at altitudes of 7,000 to 8,000 feet Neihart Baldy Mountain and Long Baldy Mountain rise above these surfaces as rounded, dome-shaped hills (17) Both of these mountains are capped by the hard, erosion-resisting Neihart quartzite, the basal member of the Belt formation The Neihart quartzite lies unconformably on the old eroded surface of the pre-Beltian gneisses and schists, it is about 600 feet thick and dips at a low angle toward the south The upper members of the Belt series of thin-bedded slates and shales with occasional interbedded layers of limestone and quartzite are found farther to the south and east Erosion has removed both the Neihart quartzite and the upper part of the Belt series, as well as all later formations, from an irregularly shaped area extending from about 1 mile south of the town of Neihart to a short distance south of the town of Barker, a distance of about 10 miles The average width of the eroded area is about 8 miles Archean or pre-Beltian rocks are exposed within this area (29)(17) These rocks are highly metamorphosed, contorted, red and gray gneisses and schists that have been intruded by igneous masses, dikes, and sills

Most of the economically important metallic mineral deposits in Cascade County occur in fissures in the igneous rocks to the east and northeast of the town of Neihart. A few outlying deposits have been found along or near igneous-sedimentary contacts, but these have not been explored extensively and have produced only a small amount of ore

A considerable amount of ore has been mined from claims in Cascade County just west of the county line near Barker The metallic mineral deposits in this area are mainly replacements along or near the contact of intrusive rocks with Cambrian shales or Carboniferous limestone

No metallic mineral deposits are known to be present in the sedimentary formations distant from the igneous rocks Several deposits of nonmetallic minerals occur in the sedimentary beds at points not far distant from masses of igneous rock These may have been formed by hydrothermal processes following the igneous activity Other nonmetallic deposits occur interbedded with sedimentary formations that were unaffected by igneous or hydrothermal action

LABOR SUPPLY AND WAGE SCALES

In the Montana (Neihart) and Barker districts mining has been done intermittently, depending largely on the price of silver During the early days the claims were operated under lease, mainly by individuals or small companies During boom times, when larger companies operated in the two camps, the scale of wages prevailing in the Butte district usually was adopted In recent years most of the miners have drifted away If operations should be resumed, skilled labor would have to be recruited from Butte or other mining centers Unskilled laborers probably would be available during the winter months when farming and stock raising generally are curtailed

Present wages in the Butte area range from $10 61 for surface labor to $12 36 for hoistmen per 8-hour shift Miners, timbermen, underground shovelers, and underground mucking machine operators are paid $11 11 for an 8-hour shift The rate for mill operators is $11 36 These rates are for a 40-hour week for men working on day shift The afternoon, evening, and graveyard shifts are paid a differential of 4, 6, and 8 cents an hour in addition to the base rate. Time and one-half is paid for overtime

MATERIALS AND SUPPLIES

Small tools, light mining equipment, and supplies can be obtained at Great Falls Heavy mining and milling equipment would have to be obtained from Helena, Butte, or more distant supply points.

Mine timbers can be obtained locally from independent contractors The cost of rough-sawn timber has increased considerably, owing to increased labor costs and to the greater length of haul Plenty of small, lagging-size timber is available in the vicinity of Neihart and Barker

Gasoline, Diesel oil, and lubricating oils are obtainable at Neihart or Monarch, where several oil companies maintain storage tanks Where roads permit, the oil companies will deliver their products to the mines The price of fuel oil used for heating purposes, deliv red at Neihart, was 15 to 16 cents a gallon in September 1949

Explosives suitable for mining purposes are available in small quantities from dealers in Neihart and Monarch Larger quantities are available at Great Falls Prices for mining explosives are comparable with prices prevailing at Butte They range from $14 75 to $23 75 a hundred pounds, depending on the type, strength, and quantity

POWER

The Neihart and Barker districts have been supplied with ample electric power for many years by the Montana Power Co This company's 110,000-volt transmission lines, extending south from Great Falls to Two Dot, pass through Monarch and Neihart These lines are interconnected with the recently constructed 110,000-volt transmission lines that extend from Great Falls to Stanford and Harlowton

A large transformer station is maintained near Monarch From this station, 23,000-volt distribution lines extend to Barker, Hughesville, and Neihart Branch lines serving the mines in these areas are being maintained in good condition As the two main 110,000-volt transmission lines are interconnected between Two Dot and Harlowton, either or both of them can be utilized at Neihart, time loss due to power-line failures can be kept at a minimum

Charges for electric energy supplied by the Montana Power Co are based on a sliding scale for actual kilowatt-hour consumption plus a charge based on peak demand

Montana Power Co Schedule GS-44, approved by the Montana Public Service Commission in September 1944, became effective October 1, 1944 The rates are as follows

Montana Power Co Power Rates - Schedule GS-44

$0 75	for the first 12 kw -hr or less	
035	per kw -hr	for the next 288 kw -hr
025	per kw -hr	for the next 1,500 kw -hr
015	per kw -hr	for the next 3,200 kw -hr
009	per kw -hr	for the next 15,000 kw -hr
007	per kw -hr	for the next 200 kw -hr per kw of demand
.005	per kw -hr	for all additional kw -hr

Plus demand charges

First 10 kw	No charge
Next 20 kw	$0 95 per kw of demand
All additional kw	75 per kw of demand

The hydroelectric generating plants of the Montana Power Co near Great Falls have a total capacity of about 235,000 horsepower

From Great Falls, high-voltage transmission lines extend to most of the larger communities in central and western Montana, they are interconnected with lines from other generating plants owned by the Montana Power Co Low-voltage lines extend through many rural areas and to most of the mining districts in the western part of the State

TRUCKING RATES

Trucking rates from the mines to the railroad or smelters depend on road conditions, road grades, loading and unloading facilities, size and regularity of shipment, and the length of the haul Before 1943, when the railroad served Neihart and Barker, ore and concentrates were loaded directly into railroad cars by the operators or were transported for comparatively short distances from the mines to loading platforms on the railroad Since the removal of this railroad, most of the silver-lead ores and concentrates have been trucked directly from the mines or mills to the smelter at

East Helena This has been found to be more economical than trucking to Armington and shipping from there to East Helena by rail, it avoids reloading into cars and the higher rail freight rates for the higher grades of ore or concentrate During the spring of 1949, the contract truck haulage cost from Neihart to the East Helena smelter via Armington and Great Falls, a distance of 160 miles, was $6 a ton, or about $0 0375 a ton-mile When trucked via White Sulphur springs and Townsend, a distance of 118 miles, the rate was $0 050 a ton-mile

Zinc concentrate sent to the zinc plant at Great Falls is shipped by rail from Armington, as there are no facilities for handling truck loads at the zinc plant The contract price for hauling zinc concentrate from Neihart to Armington in the spring of 1949 was $2 50 per ton This price included loading into cars at Armington

RAILROAD FREIGHT RATES

The only railroad point in Cascade County from which ores and concentrates now are shipped to Montana smelters is Armington on the Great Northern Railroad Railroad freight rates on ores and concentrates per ton in minimum 30-ton carload lots as of October 1949 from Armington to the three Montana smelters via the Great Northern Railroad were as follows

Value per ton, not exceeding -	$15	$25	$35	$50	$100	Over $100
To A S & R Co smelter, East Helena, Mont	$2 41	2 94	3 47	3 86	4 13	4 66
To Washoe Sampler, A C M Co, Butte, Mont	3 34	3 72	4 31	4 76	5 05	5 65
To A C M Co zinc plant, Great Falls, Mont	1 49	1 63	1 93	2 23	2 39	2 53

SMELTER SCHEDULES

Most western smelters generally find it impossible to quote a direct blanket or open schedule for the purchase of certain ores and concentrates until applicable schedules can be established upon the analysis of representative samples submitted by the prospective shipper In many instances, favorable schedules are negotiated and based on contractual tonnage agreements between the shipper and the smelter

The following schedules for ores and concentrates at smelters in Montana have been summarized from those in effect October 1949

East Helena smelter, American Smelting & Refining Co, copper-lead-gold-silver ores and concentrates

Payments for metals

Gold - minimum paid for, 0 03 ounce per ton

Ounces per ton	Per ounce
0 03 to 3 0	$31 81825
Plus 3 0	32 31825

Silver - pay for 95 percent at average of the Handy & Harman, New York quotations, or Mint price, less minimum deduction 1 Troy ounce per dry ton

Lead - If 3 percent or over by wet assay, deduct from wet assay 1 5 units (a unit is 20 pounds) and pay for 90 percent of the remaining lead at the average of the daily published A S & R Co quotations for common desilverized domestic lead for delivery in New York City, less 1 8 cents per pound of lead accounted for

Copper - If 1 percent or over, deduct from wet copper assay 1 unit and pay for 100 percent of the remaining copper at daily net refinery quotations for electrolytic cathodes as published in E & M J Metal & Mineral Markets of New York, less a deduction of 6 cents per pound of copper accounted for

Deductions

Base charge - $8 per net dry ton for treatment of ores and concentrates having a settlement lead content of 20 percent or less, deduct 10 cents per ton for each unit of lead over 20 percent, fractions in proportion, $7 per ton for those having no payable lead content

Arsenic and antimony (combined) - 2 percent free, excess charged at 50 cents per unit, fractions in proportion. 0 1 percent of lead content by wet assay allowed free, excess charged at 50 cents per pound

Zinc - 10 percent free, excess charged at 30 cents per unit, fractions in proportion

Sampling and assaying - Charge $10 per lot when less than $200 value and $20 per lot when over $200 value for shipments of less than 5 tons dry weight Charge $5 per lot when less than $200 value and $10 per lot when over $200 value for shipments less than 10 tons dry weight

Washoe sampler, Anaconda Copper Mining Co Butte Mont , copper, gold, and silver ores and concentrates

Payments for metals

Copper - 96 percent of copper content, with minimum deduction of 10 pounds per ton, at E & M J average price of electrolytic copper for week ending Wednesday preceding date of sampling, less 2 5 cents per pound

Silver - 95 percent of silver content, with minimum deduction of 1 ounce per ton at Government price less 2 cents per ounce Silver not eligible for Government price will be paid for at open market quotation, as quoted by E & M J

Gold - 95 percent of gold content, with minimum deduction of 0 01 ounce per ton, at $20 per ounce, plus 90 percent of premium in excess of $20 67 per ounce (This is equivalent to paying for 100 percent at $31 81825 per ounce)

Treatment charge, f o b Washoe sampler, Butte, Mont

Base charge - $4 per ton
Add 10 percent of sum of metal payments in excess of $15 per dry ton
Add 12 cents for each 1 percent iron (Fe)
Deduct 2 5 cents for each 1 percent of silica (SiO_2) in excess of alumine (Al_2O_3)
Maximum total treatment charge to be $5 50 per dry ton

In case company elects to have shipments made direct to the smelter at Anaconda for sampling, the base treatment charge will be $3 75 per dry ton, f o b Anaconda Reduction Works, Anaconda, Mont , with maximum total treatment charge of $5 25 per dry ton Lots of less than 10 tons will be assessed an extra sampling charge of $5 flat on each lot

Electrolytic zinc plants, Anaconda Copper Mining Co at Anaconda and Great Falls, Mont , zinc concentrates

Schedules for the treatment of zinc ores or concentrates at the Great Falls and Anaconda zinc plants are not quoted by the Anaconda Copper Mining Co Because certain impurities complicate the treatment at these plants, only certain types and grades of zinc concentrates are acceptable Acceptability is determined only after complete analysis of a representative sample of the zinc concentrate involved If satisfactory, the prospective shipper then will be offered terms of purchase

Terms of purchase of acceptable zinc concentrate by these zinc plants are indicated by the following, which pertain to shipments made by one producer in the Neihart area during the spring of 1949

Payments for metals in zinc concentrates

Zinc	Eighty percent (80%) of zinc content at St Louis price for prime western zinc
Lead	Eighty percent (80%) of lead content in excess of 3 percent at New York price, less 2 cents per pound
Silver	Eighty percent (80%) if 1 0 ounce per ton or over
Gold	One hundred percent (100%) if 0 01 ounce per ton or over, at $27 024 per ounce

Other metals No payment shall be made for any other metal or metals contained in concentrates, and such metals shall be the property of the Anaconda Co

Prices for zinc and lead shall be those quoted by Engineering & Mining Journal for week of arrival of concentrates at plants of Anaconda Co

Treatment charge

Base treatment charge shall be thirty dollars ($30) per dry ton of concentrates delivered and accepted, based on St Louis price of prime western zinc of 10-1/2 cents (10-1/2¢) per pound, a cost of labor in the zinc plants of the Anaconda Copper Mining Co at Anaconda and Great Falls, Mont , based at $11 40 per 8-hour day with the addition to or subtraction from said base treatment charge per dry ton of concentrates of 1 cent (1¢) for each 1 cent (1¢) increase or decrease in said cost of 8-hour day employment, a lead content of 3 percent (3%), and arsenic plus antimony content of 0 125 percent

There shall be added to or subtracted from said base treatment charge, 1 dollar ($1) per dry ton of concentrates for each 1 cent (1¢) per pound increase or decrease in the price of prime western zinc at St Louis above or below 10-1/2 cents (10-1/2¢) per pound, fractions proportionately Fifty cents (50¢) per dry ton of concentrates shall be added to said treatment charge for each percent (1%) lead below 3 percent (3%) in such concentrates, fractions in proportion Twenty-five cents (25¢) per dry ton of concentrates shall be added for each 1 percent (1%) of insoluble material plus iron Twenty cents (20¢) per dry ton of concentrates shall be added for each 0 10 percent arsenic plus antimony in excess of 0 125 percent

Treatment charges for typical shipments of zinc concentrates sold during 1949 to the Great Falls zinc plant by one Neihart producer ranged from $37 22 per dry ton for concentrates containing over 50 percent zinc to $43 34 per dry ton for concentrates containing 43 3 percent zinc

The zinc concentrates produced in the Neihart and Barker districts contain small amounts of arsenic, antimony, cadmium, bismuth, indium, and other metals, in addition to the lead, zinc, silver, and gold paid for by the smelters or zinc refineries Cadmium, bismuth, and indium are recovered at Great Falls in a special plant where zinc-tank slimes from the electrolytic plant are treated Production of these metals from the smelted zinc-tank slimes has been improved by the installation of a new-type centrifugal casting machine The cadmium plant has a reported capacity of 150,000 pounds of cadmium metal a month Approximately 1 pound of indium metal is recovered for each 2,000 pounds of zinc produced by the refinery No data on the quantity of bismuth recovered are available

METALLIC MINES AND MINERAL DEPOSITS

General

Metal mining in Cascade County has been confined mainly to the silver-lead-zinc deposits in the southeastern part of the county in the area around

Neihart and west of Barker (fig 1) A number of gold, lead, copper, and iron deposits in the mountainous areas north and west of Neihart have been explored, but none of them have been developed extensively, production from them has been small

Gold placer deposits were discovered in many of the gulches on the north side of the Little Belt Mountains These deposits, now in Judith Basin County, were worked on a small scale during the 1880's but generally proved unprofitable and were abandoned Gold placers have been worked intermittently by small-scale manual methods at several localities in Cascade County The deposits were small and produced only a very small amount of gold

Since the first discovery in 1881, the mines in the Montana (Neihart) district have yielded by far the greater part of the metallic mineral production of the county. However, most of these mines have been operated intermittently, many have been inactive for some years

Mines in the Barker district produced a considerable amount of silver-lead ore before 1920, when most of the district became a part of Judith Basin County Since 1920 a few mines on the Cascade County side of the Barker district have been operated intermittently, their production has not been large

The Carbonate or Logging Creek district is about 14 miles northwest of Neihart A large number of claims were located in this district years ago, many were patented A few of the patented claims extend over the divide into Meagher County Very little developing has been done When visited in 1949, there was no activity, most of the old mine workings were caved or otherwise inaccessible

The Thunder Mountain district is of interest mainly because of it iron ore deposits

The principal metallic mines and mineral deposits are described under the four district headings The locations of the properties investigated are shown by symbol and number on the accompanying Minerals Industry Survey map The symbol refers to the predominating or principal metal or metals, although such differentiation often is difficult because of varying metal content The number designates the property referred to in the Minerals Industry Survey table that accompanies the map This table provides summarized information on the metallic mines and mineral deposits investigated and on other prospects on which only very limited information is available

Montana (Neihart) District

The Montana (Neihart) district includes the area within a radius of about 5 miles of the town of Neihart Most of the larger mines are within 1 to 3 miles, some are within the Neihart townsite limits (fig 3)

The ore deposits occur principally in veins traversing pre-Beltian gneisses and schists or along the contacts of these rocks with later intrusives In an area north of Carpenter Creek, about 4 miles northeast of Neihart, the ore minerals not only occur in fissure veins but also are disseminated throughout a large mass of brecciated quartz porphyry, granite porphyry, and some brecciated gneiss (17)

More than 20 well-defined productive veins are known in the district The strike of most of these veins ranges between N 5° E to N 30° E, some strike slightly to the northwest Some dip west, others east Although most of the veins have some branches and splits, they have been persistent in continuity laterally and in depth to the deepest mine workings The veins at some of the larger mines in the immediate vicinity of Belt Creek have been developed mainly from shafts or winzes The Florence mine has been developed down to an altitude of about 5,070 feet, the lowest mine level in the district Most of the other mines are at much higher altitudes, those on the slopes of Neihart and Long Baldy Mountains are at altitudes ranging as high as 8,300 feet The vertical range between the lowest mine level and the highest outcrop in the district is about 3,200 feet The topography of the area at the higher altitudes above Belt Creek generally is favorable for the deep development of many of the veins by low-level adits

For many years after their discovery, the ore deposits were exploited mainly for their silver content The near-surface ores at most of the mines were secondarily enriched. At several mines the ore contained considerable gold During depressions only the highest-grade ores were mined As the mines attained greater depth, the ore became more base, gold and silver contents decreased Because of the high penalties for zinc, much of the ore was left or discarded as it could not be marketed profitably at the time

After selective flotation for ore concentration had been developed, many thousands of tons of material formerly thrown on the dumps or into gobs as waste were milled locally or were shipped to custom mills, where marketable zinc concentrates were produced Zinc, therefore, became an asset instead of a liability More recently, several of the mines were operated profitably because of the revenue derived from zinc concentrates, especially during the periods of comparatively high prices for base metals Increased costs for labor, supplies, freight, and transportation, together with the recent decrease in the price of lead and zinc, have been largely instrumental in bringing about the recent almost complete cessation of mining activities in the Montana (Neihart) district

Roads to the principal mines formerly were accessible during most of the year, but only a few of the main roads have been maintained Winter travel is difficult because of steep grades and deep snow Belt and Carpenter Creeks contain enough water for milling purposes during the greater part of the year Smaller streams may stop flowing during the winter and early spring

<u>Broadwater (Pb-Zn-Ag)</u>

The Broadwater mine is about half a mile east of the town of Neihart on the west slope of Neihart Baldy Mountain The claims were located in 1881 but were not actively prospected until 1886, when Colonel Broadwater acquired

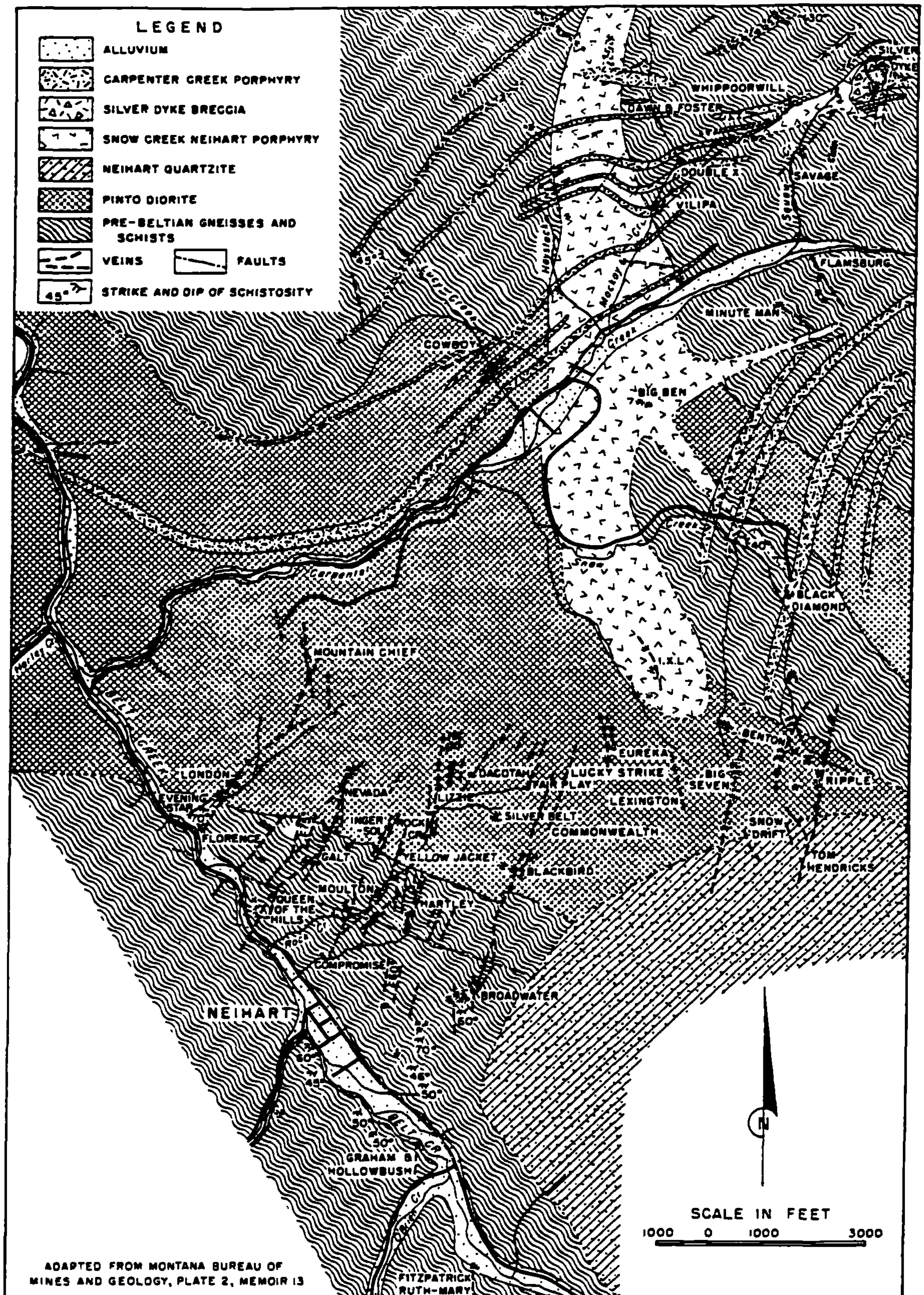


Figure 3. - Geologic map showing principal mines, Montana mining district, Cascade County, Mont.

control The ore bodies developed at that time were not considered sufficiently high grade to warrant further development, all work was suspended In 1892 the property was sold for $165,000 to W J Clark (18) The new owner at once began extensive operation, large bodies of argentiferous galena were found The mine yielded over 1,000,000 ounces of silver during the next 2 years Up to 1895, net profits are reported to have been $465,000, even though silver prices were very low In December 1896, the ore was thought to have been exhausted New ore shoots, however, soon were discovered

Control of the property then was acquired by John E. Searles, the mine was operated by the United Smelting & Refining Co , 112 miners and topmen at one time being employed (1) From January to July 1897, ore shipments averaged three carloads a week, they were then increased to 15 carloads (300 tons) a week (29) Company operations were discontinued in 1898, the mine was turned over to leasers (2) Some blocks of ore left by the company were mined during 1898-1900 In 1901 the Broadwater mine was purchased for the Diamond R Mining Co by a Mr McClure (3) Operations continued more or less continuously until 1922, when the mine was closed During the period 1901-22, net smelter returns for ore shipped are reported to have been $114,870 72, or a gross value of about $150,000 (17)

Control of the property was taken over later by the Broadwater Consolidated Mines Co During 1928 and 1929, additional developing was done This work is reported to have blocked out approximately 24,000 tons of ore between the No 3 and No 8 adit levels It was not until 1940 that mining and milling of this ore was undertaken by the Klies Mining Co A new selective flotation mill with a capacity of about 100 tons a day was constructed Operations were continuous until 1947, by which time all of the easily available ore had been mined or pulled from the old stopes During this 8-year period, 108,214 tons of ore was mined From this ore, 822 ounces gold, 381,850 ounces silver, 61,832 pounds copper, 5,974,967 pounds lead, and 7,472,786 pounds zinc were recovered (14) Production of the Broadwater mine before 1940 has been estimated to have had a value of about $5,000,000

The Broadwater claim now is owned by the estate of R E Paine, 50 Congress Street, Boston, Mass The other claims in the Broadwater group are owned by the Broadwater Consolidated Mines Co , c/o H L Maury, Butte, Mont All mine workings were inaccessible in 1949

According to Weed (29), "the main vein is strong and well-defined and traverses light-colored schists and reddish or streaked-gray feldspathic gneisses, which it crosses at nearly right angles throughout the greater part of its extent as developed At the extreme northern end, the level penetrates Pinto diorite Offshoots and splits are numerous, mostly from the hanging wall, but are not large or important " Horses of rock to 50 feet in length and to 25 feet in width were sometimes encountered. At the southern end of the property the workings indicated branching of the vein

The vein (fig 4) ranged from 3 to 6 feet in width The walls were hard and well-defined The vein material was mainly of altered country rock, it

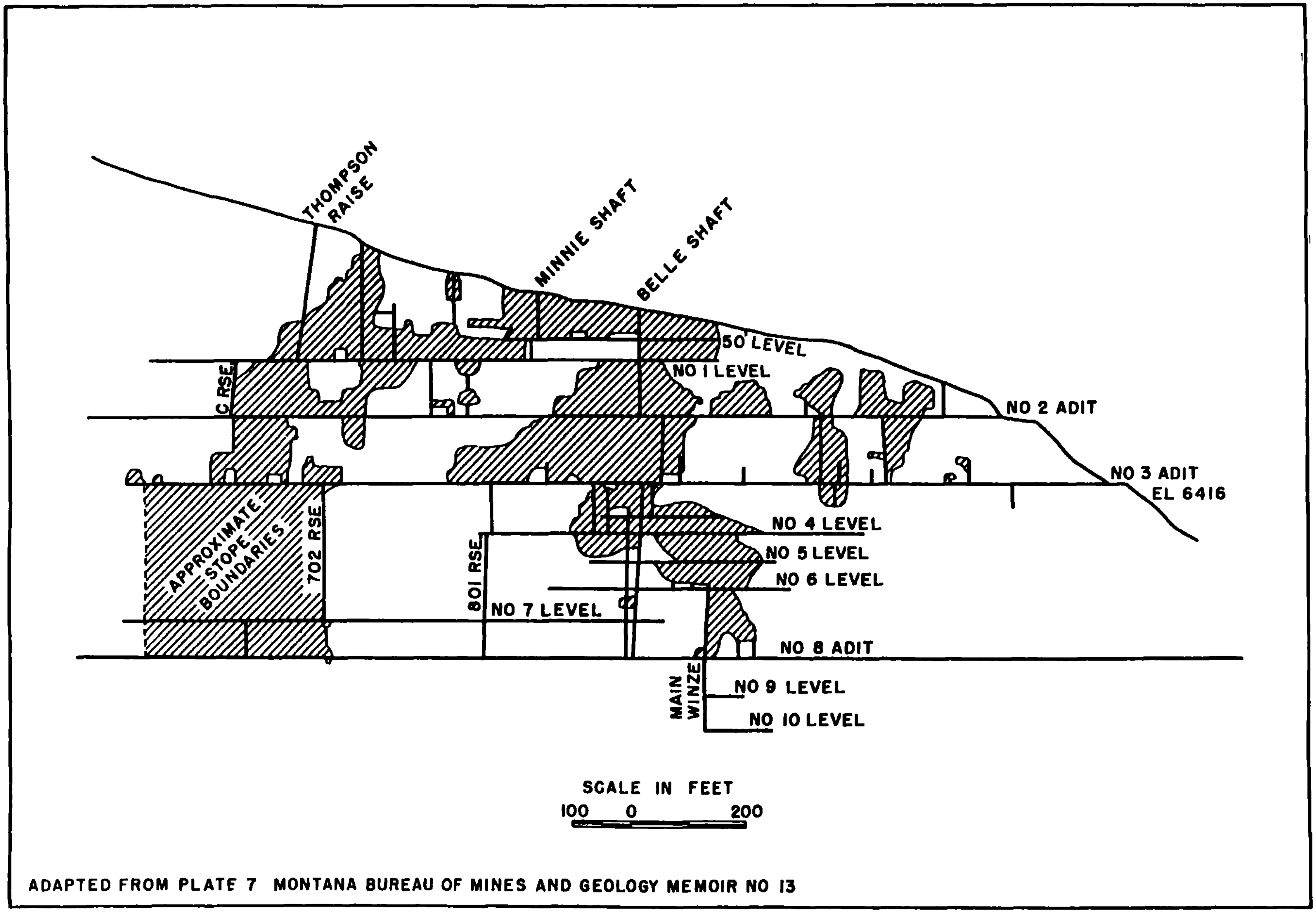


Figure 4 - Longitudinal section of main Broadwater mine workings Montana district, Cascade County Mont

was usually distinctly banded or sheeted In some parts of the mine the vein material was brecciated, fragments of country rock being cemented by barite, quartz, ore minerals, and to a lesser extend by clay In places where the vein was 4 to 6 feet wide, streaks of ore 3 to 8 inches wide occurred near both walls, either frozen to the walls or separted from them by bands of clay a few inches thick This clay, owing to films of silver sulfides, often was rich ore

Ore minerals often occurred across the entire width of the vein in the exceptionally rich ore shoots where sheeted or banded structure was not pronounced In some places, however, the banded structure was very marked owing to minute bands of spar in the darker sulfides

As in most of the mines in the district, galena, sphalerite, and pyrite were the most abundant sulfide minerals Associated with these minerals were smaller amounts of chalcopyrite, polybasite, pyrargyrite, pearceite, and proustite, which usually occurred as coatings or as small inclusions in the galena and sphalerite Ankerite, cerussite, siderite, and other carbonates usually were present in the oxidized zone Barite, rhodochrosite, and quartz were common gangue minerals

The mine was developed by three adits, two shafts, numerous raises, and a winze sunk to about 125 feet below the lowest, or No 8, adit level (fig 4) The No 8 level was driven along the vein for about 2,800 feet The No 3 adit level, at an altitude of 6,416 feet, or 300 feet above the No 8 adit, was driven on the vein for about 2,400 feet The No 2 adit level, 100 feet above the No 3 adit, was driven about the same distance Other levels driven from the old shafts extended northward and were connected by raises to workings of the Black Bird and Silver Belt mines

Five intermediate levels were driven between the No 3 and No 8 adit levels No 9 and No 10 levels were driven short distances southward from the winze sunk from the No 8 adit level, but no stoping was done Development by the Broadwater Consolidated Mines Co in 1928-29 was mainly on the No 7 level in the northern part of the mine, about 115 feet above the No 8 adit level The ore developed at that time, together with zinc ore formerly dumped into gobs, may have been mined later by the Klies Mining Co As far as can be learned, no developing was done below the No 8 adit level on the north ore shoot Most of the mine openings were inaccessible in 1949 The lowest, or No 8 adit, was closed by ice

The high-grade ore mined before 1900 is reported to have contained 20 percent zinc, 7 to 8 percent lead, and 40 to 60 ounces silver The low-grade ore contained 20 to 30 ounces silver (29) This ore probably was mined at shallow depths Between 1901 and 1921, shipments average about 50 ounces silver per ton, 5 percent lead, and 7 percent zinc (17) The ore produced from 1940 to 1947 was mined at 500 to 800 feet below the surface, much of it was obtained from old stope gobs and dumps Metal recovered from this ore per ton amounted to about 3 5 ounces silver, 2 7 percent lead, 3 4 percent zinc, and a small amount of copper and gold (14)

During the spring and summer of 1949, the King's Hill Mining Co , as lessees, milled unsorted dump material from the No 3 and No 8 adit dumps in the Neihart Mine & Milling Co 's 125-ton flotation plant at Neihart This mill formerly was owned by the Klies Mining Co The dump material was mined by a 3/8-yard gasoline-powered shovel and hauled to the mill by trucks About 65 tons of dump material averaging about 5 ounces silver, 1 0 percent lead, and 1 4 percent zinc was milled daily A lead concentrate containing about 160 ounces silver, 65 percent lead, and 9 percent zinc was shipped to East Helena by truck A zinc concentrate containing about 53 ounces silver, 5 percent lead, and 52 percent zinc was shipped by truck to Arnington and thence by rail to the Anaconda Copper Mining Co zinc plant at Great Falls Mill tails contained about 2 ounces silver, 0 2 percent lead, and 0 5 percent zinc The King's Hill Mining Co operations were terminated in July 1949, when base-metal prices became too low for profitable operation

Moulton (Pb-Zn-Ag)

The Moulton mine, another large producer, is on Rock Creek about one-fourth mile east of the north end of the main street of the town of Neihart The claim was located in the early 1880's by Jonathan McAssey and was surveyed for patent in October 1888 It was owned and operated by the Diamond R Mining Co until July 1893 By that time the mine was credited with a total production of 450,000 ounces of silver (29) The gross value of the ore with the accompanying lead and zinc must have exceeded half a million dollars (17)

A gravity concentrator connected with the mine by a tramway was constructed at Neihart during the summer of 1899 Low-grade ore and ore from the dumps of the Moulton mine were treated in this concentrator during 1900 After 1901, the mine was relatively inactive until about 1917, when it was taken over by the Cascade Silver Mines & Mills Co. Active mining resumed immediately The old mill was remodeled and during part of 1919 treated as much as 150 tons of ore a day The mill burned in May 1921 and was not rebuilt During 1918-23, inclusive, net smelter returns from ore or concentrates shipped aggregated $895,857 59 (17) Production of the Moulton mine to 1923 is estimated at approximately $1,500,000 (17) The property now is owned by the Broadwater Consolidated Mines Co , c/o H L Maury, Butte, Mont

Several veins were developed, but the Moulton vein (fig 5) was the only one mined The Moulton vein has a strike about N 30° E , the dip ranges from 80° to 90° NW The vein has been deflected on both sides of the Moulton fault, which crosses the main ore shoot at about its center However, it soon resumes its normal strike (17) According to H L Maury, the fault itself contains segregations of ore minerals

The Moulton vein is in pre-Beltian black mica schists and pink gneiss It ranges in width from 3 to 7 feet The vein material is mainly a crushed altered country rock containing disseminated sulfides, although bands or pay streaks to 2 feet in width occurred in the richer ore shoots The ore minerals are mainly galena and sphalerite with small amounts of chalcopyrite, and pyrite Intimately mixed with those minerals are proustite, pyrargyrite,

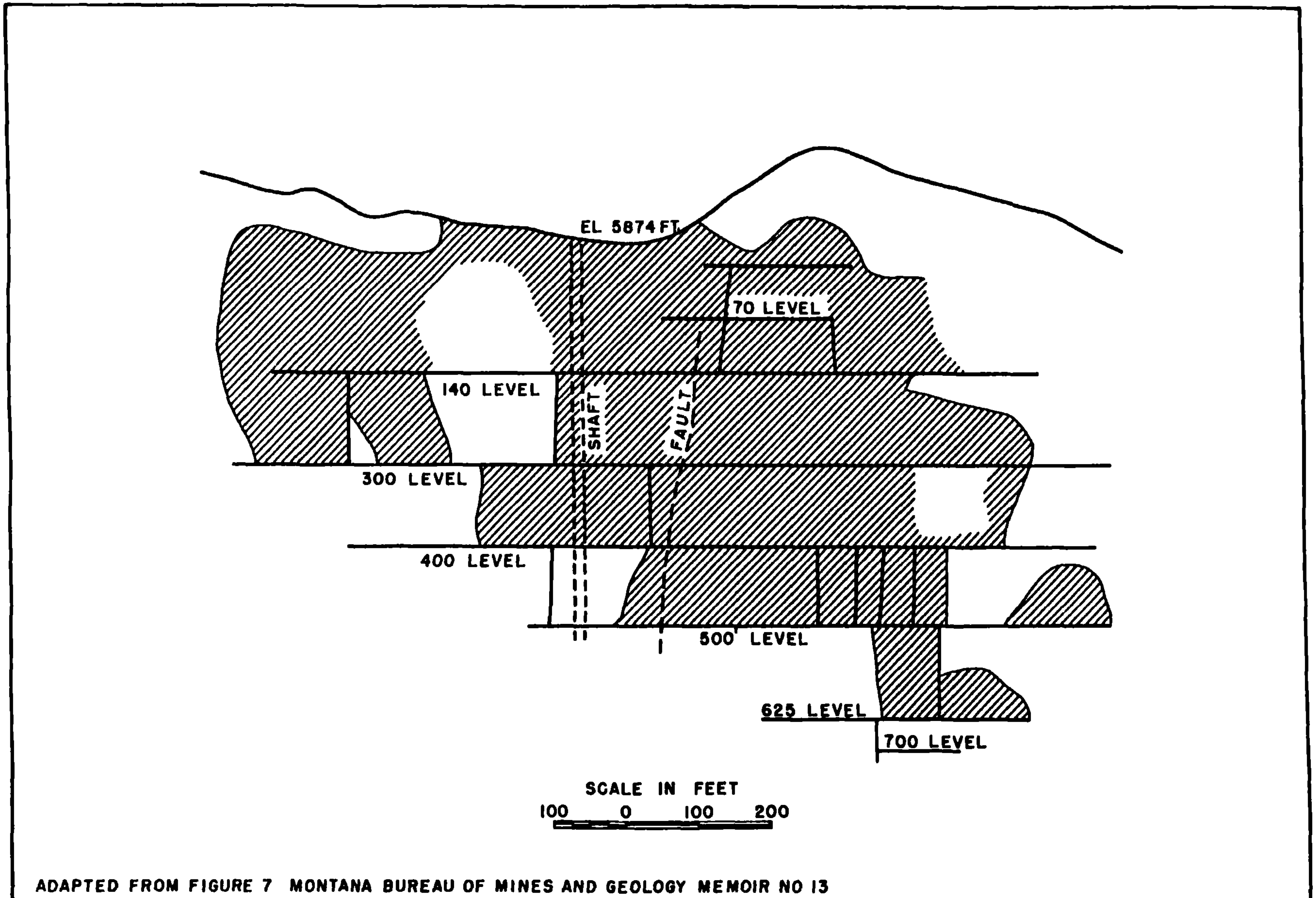


Figure 5 - Longitudinal section of Moulton mine Montana district Cascade County Mont

pearceite, and polybasite Ankerite, barite, rhodochrosite, and quartz are common gangue minerals, with siderite and cerussite usually present in the oxidized zone

The mine was developed by two adits, a 550-foot 3-compartment shaft with levels at 100-foot intervals, a 125-foot winze from the 500-foot shaft level, and a winze from the 625-foot level to below the 700-foot level (fig 5) One of the adits, known as the Blacksmith tunnel, was on the north side of Rock Creek It was driven on a vein believed to be an extension of the vein on the South Carolina or Gem claim, which adjoins the Moulton on the north No ore was encountered in this adit The other adit, which is on the south side of Rock Creek, was driven partly on the Moulton vein and several other small veins and partly on the Moulton fault Some ore was mined from one of the small veins developed by this working Virtually all of the ore produced by the Moulton mine was mined from the shaft workings

According to reports, most of the developed ore has been mined down to the 500 level, although some good ore remains According to William Thorson, Great Falls, Mont , some ore, lower in grade than the average then desired, was left above the 140-foot and 300-foot levels to the north of the shaft Some good ore was found on the 625-foot winze level, but only part of it was stoped as it contained considerable zinc, it could not be profitably mined and shipped H L Maury states that good ore was found on the 700-foot level south from the lower winze where the vein was 6 or 7 feet wide and contained two rich pay steaks each about 12 inches wide Drifting on this level was done by leasers, who produced one carload of ore that netted them $2,156. Further exploration on the lower levels ceased when the company closed the mine in 1923 Most of the higher-grade ore came from above the 300-foot level Below the 300-foot level the ore contained more zinc and less silver Average shipments from the lower levels contained about equal amounts of lead and zinc It is probably that ore of milling quality exists to a considerable depth below the present mine workings (17) All of the mine workings were inaccessible in 1949

Compromise (Pb-Zn-Ag)

The Compromise claim is one of the Moulton group It is within the town of Neihart and extends across the main street near its northern end

The claim was located March 15, 1884, by John Wilson, et al The main vein first was prospected by an adit driven about 400 feet northward toward the Moulton claim, which adjoins at the north In later years the property was operated by the Cascade Silver Mines & Mills Co , the Broadwater Consolidated Mines Co , and by various lessees Before 1930 a main adit on the Compromise claim was driven on the Moulton vein and extended into the Moulton claim Crosscuts to the east from this adit intersected other veins that extend into the Empire and the Unity claims adjoining the Moulton claim at the east Some ore was produced from these workings, but this production has been included with that of the Moulton mine About 1945 a 150-foot shaft was sunk by Spehn, Loberg, and Taylor at a point southeast from the portal of the main adit A drift was driven northward for several hundred feet on the 120-foot level of this shaft This work was terminated before the Moulton workings were reached Since then no work has been done

The veins on the Compromise and adjacent claims traverse various gneisses and amphibolites They range from a few inches to 3 or 4 feet in width The main, or Moulton, vein strikes about N 15° E and dips about 80° to 85°NW The other veins strike N 20°-50° E and dip 50°-75°SE

Because of its comparatively low altitude, the Compromise adit has been considered for use as a main haulage and exploratory adit Its extension northward to the Moulton fault and thence southeasterly along the fault would provide a haulage way from which many of the veins in the claims farther east could be developed at a considerable depth below their present workings

When visited in 1949, most of the main adit workings were open and in good condition The shaft workings were partly filled with water

Unity and Rochester (Pb-Zn-Ag)

The Unity and Rochester claims are included in the Moulton group Both claims are east of the Moulton claim The Unity claim was located February 15, 1889, by Edgar A Maclay, et al The Rochester claim was located May 1, 1884, by James F Menefee, et al Both claims now are owned by the Broadwater Consolidated Mines Co

Several veins were exposed in surface workings on both claims An adit crosscut, known as the Rochester adit, was driven eastward from the Unity claim for about 540 feet Short drifts were driven on several veins intersected by this adit, from which some ore was mined

The extension of the Rochester adit has been considered a means for developing veins on claims farther east This adit was inaccessible in 1949

Florence Mine (Ag-Pb-Zn)

The Florence mine is about one quarter of a mile north of the north end of the main street of Neihart The main workings are in the steep hillside on the east side of Belt Creek The Florence claim was located November 18, 1886, by Richard G Wight, et al The mine was operated first by the Florence Mining Co , which began operations during the summer of 1889 The lower adit was driven 420 feet, a winze had been sunk 65 feet by 1891 Some ore was produced and shipped to the smelter at Great Falls (9) When the mine shut down in 1893, the winze had been sunk to the 100-foot level with drifts started on the 50-foot and 100-foot levels (10)

The mine was idle until 1895, when it was purchased by the Florence Mining & Milling Co Unitl 1910, operations were nearly continuous During this 15-year period, the mine was developed by six adits The No 1 adit, about 30 feet above Belt Creek, is about 1,000 feet long No 2 adit, about 50 feet above No 1, is 650 feet long No 3 adit, 200 feet above No 1, is 600 feet long No 4, No 5, and No 6 adits, at successive 100-foot intervals above No 3, are each about 400 feet long A two-compartment winze was sunk at a point 135 feet in from the portal of No 1 adit to a depth of 500 feet Levels were driven at 100-foot intervals These levels, Nos 1, 2, 3, 4, and 5, extend, respectively, 960, 750, 565, 450, and 300 feet to the north and 130, 190, 240, 290, and 350 feet to the south The south drifts, except those on the No 3 and No 5 levels, terminate at the Moulton fault The No 3 and No 5 levels were driven through the fault, short crosscuts were driven east and west in attempts to locate the continuation of the vein Two small veins were intersected, but neither proved to be the main vein (17) In 1910 the lower part of the mine was allowed to fill with water All production after that time was made form the adit levels or from a resorting of the dumps In 1949, most of the No 1 adit workings were accessible All other mine workings were inaccessible, the winze was filled with water

Sometime between 1910 and 1916, the Florence, M & I, British Lion, Concentrated, and Monarch claims, which comprise the group, were purchased by Allen Pierse and E A Shaw From 1916 to 1931 about $80,000 worth of ore was produced by lessees From 1932 to 1935 the mine again was idle In 1935 the Florence Co obtained a lease and bond on the properties from the M & I Mining Co , which was owned mainly by Pierse and Shaw The Florence Co operated the mine until April 1943 The M & I Mining Co 's 60-ton flotation mill was operated until June 30, 1943, when the properties and all equipment, including the mill, were sold to the Bennett Mining Co (22-1943) This company still owns the mine but has not operated it

Production of the Florence mine from 1901 to 1943, inclusive, is reported to have been 105,189 tons, from which 98 39 ounces gold, 2,015,666 ounces silver, 11,166 pounds copper, 4,323,319 pounds lead, and 4,724 pounds zinc were recovered (14) Early shipments of ore to the smelters are reported to have contained 50 to 200 ounces silver per ton, 4 to 10 percent lead, and 3 to 10 percent zinc (17) The zinc in the ores and concentrates then shipped was not accounted for, but the quantity must have been nearly as large as that of the lead recovered

According to Weed (29), four well-defined veins occur within a width of 300 feet Only two of these had been prospected on the surface The Concentrated vein, to the north of the main Florence vein, was drifted on for about 1,500 feet It was reported to have averaged 3-1/2 feet in width and to have contained a large tonnage of milling ore A crosscut from the end of the No 1 adit encountered another vein No work has been done on these veins since the 1890's (17) Other crosscuts to the northwest from the main adit level encountered two veins, both of which were drifted on for unkown distances The first vein, about 35 feet north of the main vein, was stoped north of the crosscut both above and below the level The other vein, about 195 feet northwest from the main vein, was stoped for a short distance

According to L B Stark, Neihart, Mont , a hole diamond-drilled west from the 300-foot winze level cut a vein about 7 feet wide that was reported to have contained ore assaying 22 ounces silver a ton This vein may be the downward extension of the Concentrated vein or one of the other veins encountered to the north of the Florence vein.

The Florence vein, striking about N 10° E , ranges from about 4 to 6 feet in width It occupies a well-defined, nearly vertical fissure mainly in gray feldspar gneiss but otherwise in black amphibolite Within the vein the pay streak varied in width and position, sometimes filling the entire width of the vein Splits in the vein usually contained richer ore for short distances than the main part The sulfide minerals are galena, sphalerite, pyrite, polybasite (or pearceite), proustite, tetrahedrite, and a little chalcopyrite Gangue minerals are barite, ankerite, and quartz

The ore was secondarily enriched near the surface, but the bulk of the mining was done in primary ore (17) The ore above the developed parts of the main vein has been mined rather completely The ore on the 500 or bottom winze level is reported to have been somewhat lower in grade than that at the higher levels, but the vein was proportionally wider

Hartley (Ag-Pb-Zn)

The Hartley mine is about half a mile northeast of the town of Neihart on the northwest side of Neihart Baldy Mountain It is about three-eights of a mile east from the Moulton mine and about the same distance north of the Broadwater mine

The property was located June 20, 1883, by Thomas Angers, et al It was acquired later by William Mueller, who began shipping ore in 1901 Between 1901 and 1917, Mueller mined and shipped ore valued at $170,698 09 (17) During this time the main adit level was lengthened to about 1,000 feet, a winze was sunk from this adit level to a depth of 200 feet Little mining was done from 1917 to 1919 Mueller sold the property in 1920 to the Neihart Consolidated Silver Mining Co After this company obtained the property, the winze was sunk to a depth of 500 feet Nearly all of the vein above the 500-foot level was mined for a length of about 400 feet (17) Company operations ceased in 1924 Later operations were conducted by lessees

A small mill was operated on material from the Hartley dumps during 1928, when 380 tons of concentrates were produced. These concentrates, containing 12 1 ounces gold, 640 ounces silver, 171,803 pounds lead, and 454 pounds zinc, had a value of $38,038 82 (17) The mine was idle from 1929 to 1933 It was reopened in 1934 and operated continuously until 1940

During 1939 and 1940, the property was operated by Stewart and McVeda (21) Production during 1939 is reported to have been valued at about $17,000 The ore was milled in a 35-ton flotation plant operated by the Ruby Silver Mines, Inc (22-1940) The mine has been idle since 1940 The property, consisting of eight patented claims, now is owned by the Neihart Consolidated Silver Mining Co , Great Falls, Mont All mine workings were inaccessible in 1949

Production from the Hartley mine from 1901 to 1940, inclusive, it reported to have been 64,423 tons or ore, from which were recovered 164 04 ounces gold, 1,535,426 ounces silver, 10,028 pounds copper, 3,894,765 pounds lead, and 3,000 pounds zinc (14)

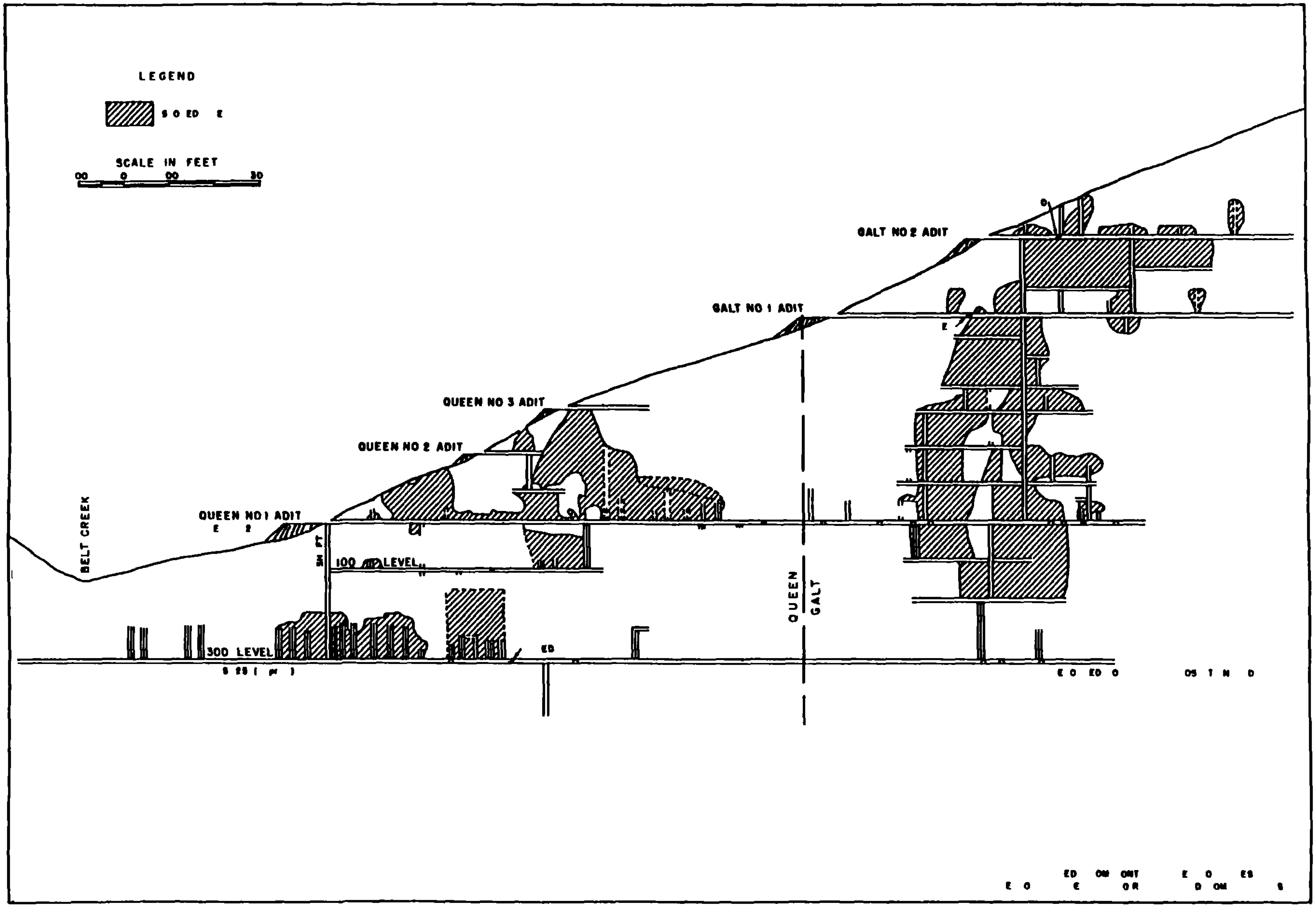


Figure 6 - Longitudinal section of the Queen-Galt vein Montana district Cascade County Mont

Three or more veins are known in the Hartley group of claims Virtually all ore mined came from the main or No 3, vein Some ore was mined by Mueller from shallow workings in the No 2 vein, but this vein never was developed at depth (17) The veins occur in gray and red gneiss The main or No 3 vein occupies a well-defined fissure ranging in width from a few inches to several feet It strikes about N 10° E and has an average dip of 50° NW. The main ore shoot was about 600 feet long, it narrowed at the north end and terminated at a fault at the south end The ore shoot raked about 50° toward the south Banding was conspicuous, druses lined with quartz were of frequent occurrence Wall rocks were not intensely altered but contained some sericite, kaolin, and fine-grained pyrite.

The sulfide minerals were chiefly galena, sphalerite, and pyrite in a gangue of crushed, altered gneiss and quartz with ankerite and barite The silver minerals were chiefly polybasite (or pearceite) and proustite Native silver in the form of wire or threadlike masses was abundant in the upper workings, especially above the 300-foot winze level Below the 200-foot level the silver content decreased markedly Ore shipments from above the 200 level, mainly from the zone of secondary enrichment, contained from 56 to 203 ounces silver, 7 to 20 percent lead, 5 to 16 percent zinc, and 0 to 0 017 ounce gold a ton Shipments from below the 200 level were mainly of primary ore, they contained 20 to 100 ounces silver, 5 to 15 percent lead, 2 to 10 percent zinc, and 0 to 0 02 ounce gold per ton Near-surface ores contained considerable amounts of limonite, cerussite, smithsonite, and probably some calamine, native silver, proustite, pyrargyrite, and cerargyrite occurred, often abundantly (17)

The main vein is reported to have been about 4 feet wide on the 500 level and to have contained ore similar to that mined up to 200 level Deeper development would be necessary before the ore below this level could be mined The No. 2 vein, which produced ore above the main adit level, has not been prospected below that level Other veins are known on the Boss claim, which adjoins the Hartley on the west The north end of the property has not been prospected

Queen of the Hills (Queen-O'Brien)(Pb-Zn-Ag)

The Queen of the Hills mine adjoins the Galt (fig 6) and Equator mines at the west The property was located in July 1881 by James J Neihart and surveyed for patent in June 1884 First development exposed such favorable conditions that the Queen of the Hills claim, together with the Homestake and O'Brien claims, which adjoin on the south and north, respectively, was optioned in 1884 for $45,000 This option was relinquished the following year Later development by the owners soon resulted in the discovery of large ore bodies, from which many shipments were made (17) After October 13, 1890, the property was owned and operated by the Queen of the Hills Mining Co. until July 1893, when operations were suspended owing to the low price of silver and lead (9) Operations were resumed in 1894 by the Queen Mining & Milling Co By 1897 the main adit was about 1,000 feet long, and a three-compartment shaft had been sunk to a depth of 300 feet, with levels at 100 and 300 feet

In 1897 the mine was closed, and the lower workings were allowed to fill with water (2) From 1898 to 1907 the mine was operated more or less continuously Much of the ore produced during this period came from the O'Brien vein

Intermittent operations have been conducted mainly by lessees since 1907 The Anaconda Copper Mining Co at one time did considerable development on the 300-foot level The mine was operated from 1926 to 1929 by Leyson Brothers, who shipped 10,551 tons of low-grade ore and dump material to the Timber Butte mill at Butte, Mont , where it was treated by selective flotation From the concentrates produced, 64 46 ounces gold, 179,548 ounces silver, 3,684 pounds copper, 1,006,251 pounds lead, and 2,002,105 pounds zinc were recovered (14)

The Queen Leasing Co took over the mine in 1940, constructed a 60-ton selective flotation mill, and began operations that continued until March 1942 The mill was dismantled and removed (22-1940) The mine has been idle ever since Ownership of the property remains with the Quenn Mining & Milling Co , Kalispell, Mont. During operations by the Queen Leasing Co , 23,068 tons of ore and dump material was milled, the metal recovery from concentrates produced therefrom amounted to 27 00 ounces gold, 68,749 ounces silver, 1,188 pounds copper, 400,002 pounds lead, and 81,600 pounds zinc (14)

Ore produced from the Queen of the Hills mine, including that from the O'Brien vein, from 1894 to 1928, inclusive, is reported to have had a value of $437,559 67 (17) No production is recorded for the years 1930 to 1939, inclusive Production from 1901 to 1942, inclusive, is reported to have been 41,358 tons of ore, from which 130 78 ounces gold, 430,629 ounces silver, 4,872 pounds copper, 2,037,465 pounds lead, and 2,160,105 pounds zinc were recovered (14)

The Queen vein was developed by three adits and a 300-foot shaft with levels at 100 feet and 300 feet (fig 6). The two upper adits were short The lower adit was driven northward on the vein to about 400 feet from the end line of the Galt claim, shich adjoins on the northeast From this point the adit was extended northward by the Galt Mining Co into the Galt claim and under the higher Galt mine workings The 300-foot shaft level later was extended northward into the Galt claim It also was driven southward for a distance of about 650 feet

The O'Brien vein was developed by an adit drift about 400 feet long driven on this vein from near the northern end of the Queen of the Hills claim A 300-foot crosscut also was driven westward to the O'Brien vein from a point about 950 feet in from the portal of the Queen adit An unknown footage of drifting then was done A vein believed to be the O'Brien was intersected by a crosscut from the 300-foot level of the Queen shaft and drifted on for about 550 feet

The Queen vein strikes about N 25° E , its dip ranges from nearly vertical to 75° SE The O'Brien vein has about the same strike as the Queen vein but dips about 75° NW Both veins are in light-colored feldspathic gneiss in the Queen of the Hills claim In the Galt claim, farther to the north, the Queen vein crosses a rhyolite porphyry dike, then enters Pinto diorite, where it narrows and becomes unproductive (17) On the Queen of the Hills claim, the Queen vein ranged from 1 to 6 feet in width In places on the Galt claim the vein was 10 feet or more in width

The sulfide minerals in the ore are chiefly galena, sphalerite, and pyrite, with small amounts of chalcopyrite, pyrargyrite, polybasite or pearceite, and proustite The Gangue minerals are quartz, ankerite, and barite In the oxidized upper parts of the veins, limonite, secondary silica, cerussite, smithsonite, native silver, and possibly cerargyrite, were present (17) Unsorted ore shipped during 1926-29 contained an average of about 17 ounces silver a ton, 4 7 percent lead, and 9 6 percent zinc (14)

According to Sam Williams, Belt, Mont , Warren Ford, Raynesford, Mont , and Paul Stark and W G Powers, Neihart, Mont , the Queen vein at the 300-foot shaft level was as wide or wider than in the upper parts of the mine but contained more zinc

When visited in 1949, the upper adits were caved The shaft apparently was in good condition but filled with water to about 75 feet below the collar All workings on the O'Brien vein were inaccessible

Galt (Ag-Pb-Zn)

The Galt mine is east of the main highway about one-eighth mile north of the north end of the main street of Neihart It adjoins the Queen of the Hills mine on the north The property first was located as the Massachusetts on January 1, 1886, by Edwin W Toole, et al Before the railroad was built to Neihart, the ore mined was dragged down the mountainside in deer skins, transported to White Sulphur Springs by pack horses, hauled by wagon to Livingston, and then sent to Omaha or Kansas City Smelters by rail The mine was operated intermittently for many years by the Galt Mining Co In 1895 an agreement was made with the Queen Mining & Milling Co , which gave the Galt Mining Co the right to extend the main Queen adit for a distance of 400 feet and to use this adit for developing the Galt vein All ore taken from the Queen vein became the property of the Queen Mining & Milling Co The Galt Mining Co agreed to pay $1 25 a ton for all ore mined from the Galt vein and trammed out through the Queen adit This agreement was for a 3-year period but later was extended from time to time, the royalty rate being reduced to $0 50 a ton

The mine was idle from 1897 to 1899 (29) It was operated during 1900 and 1901 but again was idle in 1902-1905 (3) Considerable ore was mined from 1906 to 1908 (24) The mine was closed from 1908 to 1916 (14) From 1916 until 1929 it again was in continuous operation In 1932 the Galt Mining Co was taken over by the Ford interests of Boston, Mass The company was reorganized in 1935 as the Galt Mines, Inc After 1935 the mine was operated by the Lexington Mining Co , then by William Derringer of Great Falls, Mont , and finally by Stark and Rives, who purchased the Galt and Equator claims To avoid payment for the right to tram ore through the Queen adit, a crosscut was driven to the Galt workings from the Equator claim During the summer of 1949, the lower Galt adit was being reopened Ore recovered from this level was treated in the Star Mining Co 's flotation mill until operations ceased in August The Galt mine now is owned by L B Stark, Neihart, Mont

The mine is developed by two upper adits, by the extension of the main Queen of the Hills adit, by the extension of the 300-foot drift driven from the Queen shaft, and by a crosscut adit from the Equator claim Several intermediate levels between the Queen adit and the lower Galt adit also have been driven in the main ore shoot Other working levels have been driven between the 300-foot level of the Queen shaft and the main Queen adit (fig 6) When visited in 1949, a part of the lower of the two adits had been rehabilitated and was accessible for a distance of a few hundred feet All other workings were closed by caving

According to Warren Ford, Reynesford, Mont , the Galt mine was the first mine to be operated successfully in the Neihart area Up to 1920 the mine had produced over 800,000 ounces of silver valued at $552,000, about $100,000 in dividends had been paid In a letter written by Frank Marion in 1920, it was stated that the ore was very rich in many places At one place the vein was 16 feet wide and averaged 70 ounces silver a ton Several small carloads of ore netted from $3,600 to $5,327 a carload In 1928 Jesse L Maury estimated total production to have been about $1,000,000 (17)

It is known that a large production was made before 1901, but no records are available Production from 1901 to 1948, inclusive, is reported to have been 20,961 tons of ore, from which were recovered 145 22 ounces gold, 476,584 ounces silver, 5,010 pounds copper, 1,798,223 pounds lead, and 706,927 pounds zinc (14)

The Galt vein occurs mainly in light-colored feldspathic gneiss, but near the north end of the claim it is in Pinto diorite and black amphibolite gneiss At several places the vein follows along a rhyolite porphyry dike It ranges from 1 foot to as much as 20 feet in width Its general strike is N 20° to 30° E Where most productive, the vein stands nearly vertical in the lower levels the dip ranges from 70° to 80° SE The wall rocks generally are altered for considerable distances from the vein (29) The vein material is mainly crushed altered country rock containing bands or lenses of sulfide minerals These sulfide minerals are chiefly galena, sphalerite, and pyrite with which polybasite, pearceite, proustite, and pyrargyrite are intimately associated Carbonates and oxides were of common occurrence in the near surface workings Other than altered country rock, the principal gangue minerals are quartz, ankerite, and barite The vein splits along both sides at numerous places, these splits generally were very productive at and near the main vein Sampling of the ore body at a depth of 950 feet below the surface in 1928 by Jesse L Maury indicated an average of 19 8 ounces silver a ton, 4 5 percent lead, and 4 5 percent zinc (17)

Star (Ag-Pb -Zn)

The Star mine is on the east side of belt Creek about half a mile north of the north end of the main street of Neihart The present Star mine holdings are a consolidation of the Evening Star and London properties The London vein was discovered and prospected by shallow surface workings and by two adits during the early mining days Considerable amounts of shipping-grade argentiferous lead carbonate ores were produced from the shallow workings Later, the main Star adit was driven to develop the southerly extension of the London vein Several small ore shoots were encountered and mined The high zinc content of the ore shipped caused the imposition of heavy penalties by the smelter This discouraged further development, operations ceased From 1906 to 1915 lessees shipped small amounts of ore After 1915 small tonnages were mined annually until 1922 After 11 years of inactivity, lesses again began operations in both the Evening Star and London claims, intermittent shipments were made until 1939 In that year Mrs Loretta Rives of Conrad, Mont , became the owner of the properties A 50-ton bulk flotation mill was constructed From 1940 to 1948 the properties were operated by Mrs Rives, by the Loretta Rives Syndicate, and by the Star Mining Co , which was owned equally by Mrs Rives and L B Stark of Neihart, Mont About 1944 the mill was remodeled for selective flotation Ore from the Star mine and from the Galt and Equator claims, which had been acquired by the Star Mining Co , was milled After Mrs Rives' death in 1949, Stark purchased the Rives interests

Production records for the years prior to 1901 are not available From 1901 to 1936, inclusive, the recorded production from the London group is reported to have been 618 tons of ore, from which were recovered 74 35 ounces gold, 28,421 ounces silver, 235 pounds copper, and 137,717 pounds lead (14) Ore production from the present Star group of claims from 1901 to 1948, inclusive, which includes ore produced from the London claim during 1941-48 and also from the Galt and Equator claims during 1944-47, is reported to have been 54,610 tons Metal recovery from this tonnage amounted to 626 90 ounces gold, 216,197 ounces silver, 9,428 pounds copper, 1,948,841 pounds lead, and 552,377 pounds zinc (14)

The Star mine is developed by three adit drifts, numerous raises, and three short winzes Two of the adits are on the London claim The Star adit, 2,218 feet long, is at an altitude of 5,600 feet, or 134 feet below the lower London adit, it is the main haulage and working level Two ore shoots were found on this level One of these, encountered about 240 feet from the portal, was about 125 feet long, the other was farther north under the lower adit of the London claim It is reported that lead-zinc ore was encountered still farther north when the Star Mining Co extended the main adit (17) Three winzes were sunk below the Star adit, but no mining has been done below the adit level One of the winzes about 330 feet in from the adit portal was sunk to a depth of about 60 feet, another winze sunk in the vein below the London ore shoot was about 20 feet deep (17) The depth of the third winze is not known

The Bureau of Mines conducted a small amount of development and exploratory work on the property in 1944 An old crosscut about 25 feet long, driven northwest from a point about 1,000 feet in from the portal of the Star adit, was advanced an additional 140 feet by the Bureau of Mines A strong vein having approximately the same strike and dip as the Star vein was encountered 145 feet in from the junction of the crosscut and the main adit

Where intersected by the crosscut, the vein was 5 5 feet wide but was weakly mineralized A 6-inch band of quartz and gouge near the center of the vein contained small amounts of lead and zinc sulfides A horizontal diamond drill hole then was drilled N 46°31'W for a distance of 700 feet beyond the face of the crosscut A narrow vein was cut between 39 5 and 41 5 feet from the collar of the hole Another vein in bleached diorite was cut between 462 and 466 feet Sulfide minerals were present in the core and sludge, but analyses showed them to be generally low in metal content (7)

The Star vein is in a strong, persistent, sheeted fissure that cuts mainly granite gneiss in the Evening Star and Morning Star claims at the southwest To the northeast in the London claim it is in Pinto diorite The vein has a general strike of N 30° E and a steep dip to the northwest Local changes in strike are numerous, especially where changes in formation occur The London ore shoot, the principal ore body in the mine, was more than 600 feet long as exposed in the Star adit, it has been mined throughout a vertical range of 400 feet Several shorter ore shoots have produced some ore Vein widths range from 4 to 17 feet, but the higher-grade ore usually is confined to bands 4 inches to 2 feet in width The rest of the vein filling is altered gneiss or diorite, gouge, and crushed sulfides Except where the vein material was exceptionally low grade, the entire width of the vein was mined for mill feed The vein is offset by several cross faults, generally of small displacement Strong strike faults, however, crushed and ground the ore (7)

Ore mined in the earlier days from the surface and shallow underground workings was shipped to the smelter, it contained lead carbonate with a high silver content With increased depth the ore became complex, consisting of galena, sphalerite, chalcopyrite, pyrite, stephanite, pyargyrite, and some native silver Ore mined in recent years was relatively low grade

The Star mine has been inactive since about 1945 The Star mill, however, continued to mill ore and gob material obtained from the nearby Galt and Equator mines When visited in 1949, mill operation was suspended temporarily the main Star adit was inaccessible owing to a cave at the portal The upper adits also were closed by caving

<u>Equator (Pb-Zn-Ag)</u>

The Equator mine is south of the Galt mine and a few hundred feet east of the north end of the main street of Neihart

The claim was located December 31, 1887, by Martin Barrett, et al Little could be learned of its early history About 1918 it was purchased by the Galt Mining Co to provide a site for an adit that was to be driven under the Galt upper workings This proposed work was not done until many years later when both the Galt and Equator claims were acquired by Rives and Stark These claims now are owned by L B Stark, Neihart, Mont

The vein on the Equator claim was developed by an adit drift driven northward to the old Galt workings A parallel vein about 25 feet west of the main vein was intersected by a crosscut and drifted on When visited in 1949, ore was being stoped from both the main vein and the parallel vein Both

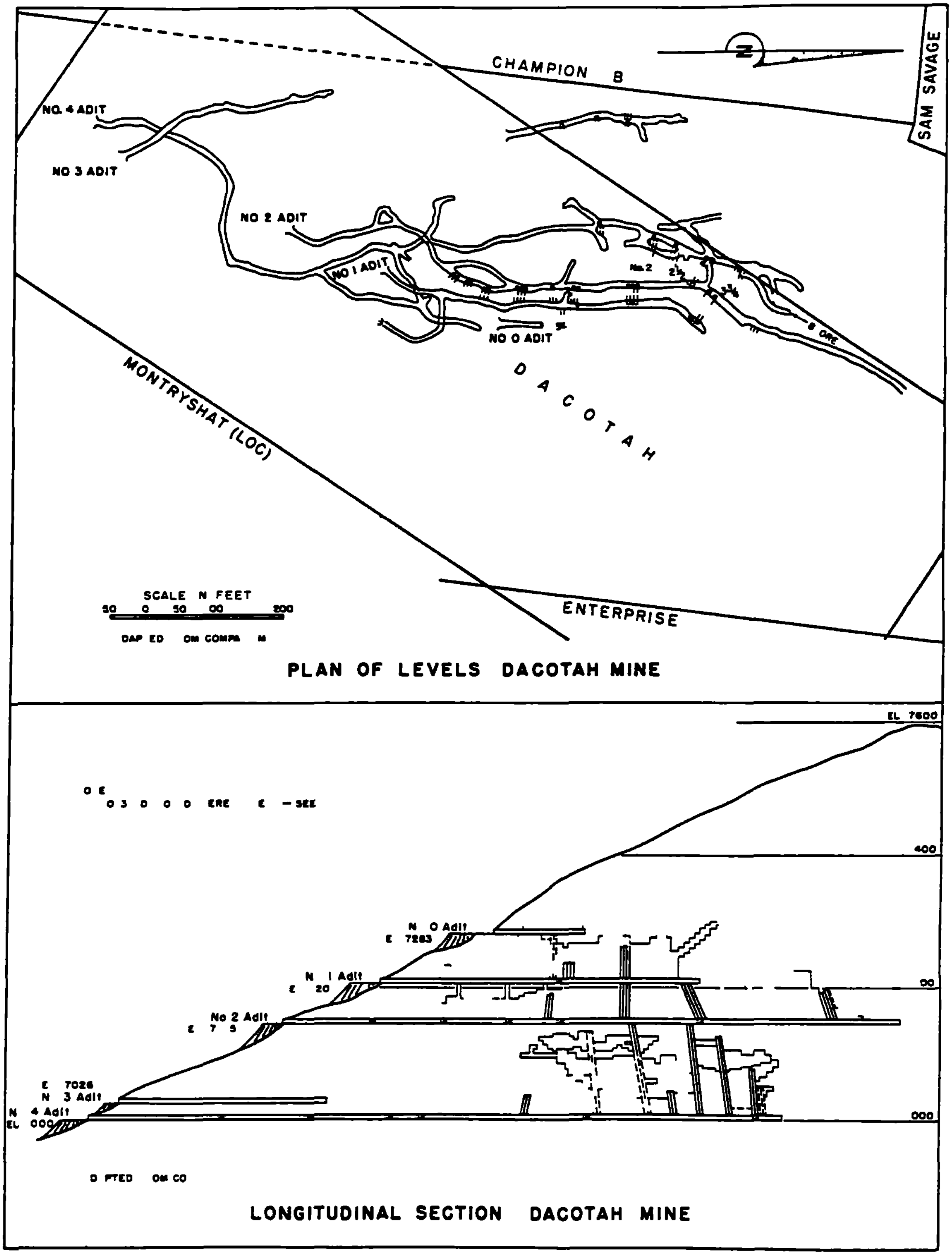


Figure 7 - Plan and longitudinal section Dacotah mine Montana district Cascade County Mont

veins are norrow, ranging up to 2-1/2 feet in width, they traverse a light-colored gneiss The main vein is nearly vertical, the west vein dips about 75° toward the east Both veins strike about N 15° E

Production records for the Equator mine prior to 1915 are not available Production from 1915 to 1917, inclusive, is reported to have been 364 tons of ore, from which 12 08 ounces gold, 13,367 ounces silver, and 273,309 pounds lead were recovered (14)

The Equator mine has been operated on a relatively small scale since 1944 by the Star Mining Co , the ore being milled in that company's 50-ton selective flotation plant In the spring of 1949, most of the Star Mining Co production was made from Equator ore and gob material from the Galt mine This combined mill feed is reported to have averaged about 5 ounces silver, 2 7 percent lead, and 2 percent zinc Production from the Equator mine during recent years has not been recorded separately but has been included in the production of the Star Mining Co

When visited in 1949, the Equator adit was open and in good condition for a distance of about 1,300 feet

Dacotah (Ag-Pb-Zn)

The Dacotah mine (fig 7) is about 1 mile northeast of Neihart at the head of Rock Creek It was located in 1883 by the father of the present owners The property holdings, consisting of three patented claims and one unpatented claim, first wero prospected by shallow surface workings and two short adits It was leased to the Neihart Mining Co in 1891 and operated intermittently by that company for several years (9) When visited by Weed (29) in 1897, the mine was idle At that time the main adit was closed by a cave about 300 feet in from the portal

The mine was operated in 1911 and 1912 by Charles Whitcomb & Co (26) It was idle again until about 1924, when it was reopened, and some mining was done until 1926 (22-1926) The mine then remained closed until 1942, when Carrol Bennett organized the Bennett Mining Co A development loan was obtained from the Reconstruction Finance Corporation The old Florence mill, acquired from the M & I Mining Co , was remodeled for selective flotation to treat about 60 tons of ore a day Mine and mill were operated continuously until the latter part of 1945 During this period about 2,000 tons of zinc concentrate and about 800 tons of lead concentrate were shipped Revenue from these shipments was sufficient to repay the R F C loan and also realize a profit The mine was reopened in 1946 and operated until May 1949, when the drop in lead and zinc prices caused suspension of mining and milling All holdings of the Bennett Mining Co are owned by Carroll R Bennett, Mrs Frances A Clarke, and Josephine A Bennett, all residing at Great Falls, Mont

No production records previous to 1924 are available During 1924-26 production is reported to have been 456 tons of ore, from which were recovered 6 42 ounces gold, 3,433 ounces silver, 148 pounds copper, 70,757 pounds lead, and 93,489 pounds zinc (14)

Production records from 1942-49 are not available for publication Such records as are available indicate the production during this period to have been more than 1,000,000 pounds of lead, nearly 3,000,000 pounds of zinc, appreciable amounts of silver, and some copper and gold

The Dacotah vein has been developed by four adits ranging from 100 to more than 1,200 feet in length (fig 7) Two other adits about 300 feet and 260 feet long were driven on two other veins, from which some ore was mined during the early days

According to an unpublished Bureau of Mines report, the Dacotah vein, in the central part of the Dacotah claim, follows a strong well-defined fissure in light-colored gneiss As it continues northeasterly it enters Pinto diorite, where it tightens and narrows for a considerable distance, particularly along the No 4 adit level The strike of the vein in the gneiss is almost due north, it ranges from N 20° E to N 40° E in the Pinto diorite The average dip is about 60° to the west The Dacotah vein ranges from 2 to 8 feet in width The vein material is mainly crushed altered country rock containing galena, sphalerite, pyrite, and silver sulfides in bands and disseminations

Mine-run ore milled in 1949 contained zinc and lead in a ratio of about 2 5 1 The zinc concentrate produced averaged about 52 percent zinc, 3 to 4 percent lead, 0 5 ounce gold, and about 7 ounces silver a ton The lead concentrate contained an average of about 55 percent lead, 6 to 9 percent zinc, 0 2 ounce gold, and 20 ounces silver

Development in recent years from the north end of the No 4 adit encountered a rich wide ore shoot which, however, was not opened before the mine closed Good ore was developed on the No 2 adit 145 feet above and about 200 feet farther to the north of the face of the No 4 adit Bulldozer trenching on the surface exposed the vein to the north of the mine workings

The vein has had little development above the No 1 adit level, although some stoping has been done from that level and the No 0 adit level (fig 7) The Dacotah ore shoot as developed and mined rakes about 35° N Indications are that ore may continue northward for a considerable distance beyond the present faces of the No 2 and No 4 adits Development below the No 4 adit level would require sinking from that level or the driving of a long adit at a lower altitude

When visited in 1949, mine and mill operations had suspended The No 2 and No 4 adit workings apparently were in good condition but were tightly barricaded so that access was impossible

<u>Silver Belt (Ag-Pb-Zn)</u>

The Silver Belt mine is about 3,000 feet north of the Broadwater mine and about 1 mile northeast of the town of Neihart It is at a high altitude on the west slope of Neihart Baldy Mountain

The claim was located September 7, 1888, by James L Neihart It was purchased from Neihart by D L S Barker, et al, in 1900 (3) Barker operated the mine until 1919, when it was sold to the Neihart Silver Mines Co , Neihart, Mont (17) This company, which still owns the property, operated it intermittently until 1927 The mine was not worked again until 1935 From 1935 until 1938 the mine was worked through the Broadwater mine, from which workings had been extended through the Black Bird claim and north along the vein under the old Silver Belt workings Since 1939 only a small amount of ore has been mined by lessees

Production records for years previous to 1900 are not available Net smelter returns for ore shipped between 1900 and 1927 are reported to have aggregated $212,920 12 (17) Production from 1902 to 1941, inclusive, is reported to have been 62,175 tons of ore, from which were recovered 585 59 ounces gold 449,610 ounces silver, 1,183 pounds copper, 663,607 pounds lead, and 46,970 pounds zinc (14)

The vein first was explored by a shallow shaft sunk on the vein Later, a 425-foot crosscut adit was driven to the vein Ore was mined above that level from a drift A 100-foot winze then was sunk from this adit level An ore shoot, encountered 15 or 20 feet south of the winze, was mined to the adit level Three shoots of ore north of the winze also were mined (17) The downward extensions of these shoots probably were mined later from the upper workings of the Broadwater mine The vein on the Silver Belt claim was considered to be either the main Broadwater vein or a branch from it It traverses Pinto diorite near its contact with gneiss According to Paul Vuovic, Neihart, Mont , the vein split into narrow stringers near the central part of the claim Its general strike was about N 10° to 20° W The dip was nearly vertical, or steeply to the west

Although the vein was narrower in the Pinto diorite than in the gneiss, it contained very rich silver ore Early shipments are reported to have contained 20 to 300 ounces silver, 2 to 20 percent lead, 4 to 30 percent zinc, and 0 02 to 0 80 ounce gold a ton Secondary enrichment of the vein from 100 to 150 feet below the surface probably was responsible for the large silver content of the ore mined to that depth (17)

When visited in 1949, the old upper workings were covered with slide rock The main adit was closed by a cave at the portal

<u>Black Bird (Ag-Pb-Zn)</u>

The Black Bird claim contains the northward extension of the Broadwater vein It is about three-fourths of a mile east of Neihart, one-fourth mile north of the Broadwater mine, and one-eighth mile east of the Hartley mine

The claim was located August 20, 1890, by Homer Thomas It was worked intermittently by the owners and lessees before 1923 It now is owned by Neihart Silver Mines Co , Neihart, Mont

Most of the production was made between 1915 and 1922 when mined through the upper workings of the Broadwater mine Net smelter returns to 1935 are reported to have been $33,960 40 (17) Production data for years previous to 1915 are not available Production from 1915 to 1921, inclusive, is reported to have been 539 tons of ore, from which 66 01 ounces gold, 46,760 ounces silver, and 71,489 pounds lead were recovered (14)

First development consisted of a shallow shaft and open pits Later, a crosscut adit was driven S 45° W This adit, about 185 feet long, was driven through hard Pinto diorite for about 110 feet, then into silicified, altered gneiss A narrow vein was intersected at about 125 feet The main vein was intersected about 50 feet beyond Drifts were driven northward and southward on both veins A short crosscut was driven east from the north drift on the main vein A third vein was intersected by this crosscut All three veins were stoped irregularly above this adit level A raise from one of the upper levels of the Broadwater mine was driven to the main drift All of the veins are narrow quartz-filled fissures ranging from half an inch to 2 feet in width Sooty silver sulfides, galena, sphalerite, and pyrite occur in and alongside the quartz

A Bureau of Mines sample chipped from a 1-inch quartz band showing in the back of the first drift at a point about 125 feet north of the crosscut assayed 10 8 percent lead, 14 percent zinc, 53 3 ounces silver, and 0 05 ounce gold

When visited in 1949, the main crosscut adit and the north drifts were open and in good condition The south drifts were blocked by caving about 100 feet south of the crosscut The old surface pits were covered with slide rock

Spotted Horse (Au-Ag)

The Spotted Horse claim is at a high altitude on the west slope of Long Baldy Mountain, about 2-1/2 miles southeast of Neihart It was located in the early days, but little could be learned of its history The claim now is owned by J J Stewart, Spokane, Wash , Howard A Murray, Annie H Maury and Verna E Shone, each holding a one-quarter interest No production data are available, but it is known some ore has been shipped from the property

The underground development consists of a crosscut adit about 120 feet long and a drift driven southward from the end of the crosscut for several hundred feet

The vein ranges from a few inches to about 3 feet in width It strikes N 15° to 20° E and stands nearly vertical It traverses Pinto diorite and gneiss Both walls of the vein are highly altered and kaolinized The vein material is mainly altered diorite or gneiss with a narrow stringer of quartz Pyrite is disseminated in the vein material and in some places occurs in small masses along the walls No silver, lead, or zinc minerals are in evidence

A Bureau of Mines sample of sacked ore found in a small cabin near the adit portal assayed 1 02 ounces gold, 44 4 ounces silver, less than 0 05 percent lead, and less than 0 1 percent zinc

When visited in 1949, the crosscut adit was in good condition The drift was accessible but in poor condition for about 200 feet, where it was blocked by a cave

Broken Hill (Ag-Pb)

The Broken Hill mine is on the west slope of Neihart Baldy Mountain, a short distance east of the Broadwater mine The claim was located in the 1880's, but little could be learned of its early history or development The mine was operated by lessees from 1906 to 1911 and again from 1919 to 1921 Production records prior to 1906 are not available Production from 1906 to 1921, inclusive, is reported to have been 769 tons of ore, from which were recovered 0 57 ounce gold, 42,778 ounces silver, and 72,454 pounds lead (14)

The vein traverses gneiss, which in the near vicinity is overlain by Neihart quartzite It is similar in character but narrower than the Broadwater vein Underground workings now are inaccessible

Fairplay (Ag-Pb-Zn)

Fairplay claim is on the crest of the divide between Snow Creek and Belt Creek, about 1-1/8 miles northeast of Neihart It adjoins the Silver Belt claim at the north The claim was located in the 1880's No information regarding its early history or development is available The present owner is Belle L Templeman, Butte, Mont

Production data previous to 1919 are not available Production in 1919 to 1926, inclusive, is reported to have been 125 tons or ore, from which were recovered 15 98 ounces gold, 5,098 ounces silver, 28,030 pounds lead, and 21,002 pounds zinc (14) Zinc recovery was made only from a 57-ton ore shipment in 1926 In addition to the zinc, this 57-ton shipment yeilded 3 39 ounces gold, 1,125 ounces silver, and 15,575 pounds lead

According to Paul Vdovic, Neihart, Mont , the vein is a narrow filled fissure in Pinto diorite It has been developed by a short adit The ore contains galena, sphalerite, pyrite, silver sulfides, considerable cerussite, and limonite

Ingersoll (Ag-Pb-Zn)

The Ingersoll claim is one of a group of five claims adjoining the Moulton group on the north The claims are on Rock Creek and extend up the side of the main ridge about one-half mile northeast of the north end of the main street of Neihart They are owned by Vesta R Pierse, Los Angeles, Calif

The Ingersoll claim was located June 6, 1888, by Stephen Pierse Development was begun soon after location In 1891 and 1892 considerable drifting was done The main drift adit later was lengthened to 1,100 feet, and a 75-foot crosscut was driven to the west from a point near the face of the adit A 112-foot raise was driven at a point 400 feet in from the adit portal A drift from the top of the raise was driven to the surface (9) This upper drift later was extended northward for about 150 feet and exposed a short ore shoot The west crosscut from the main adit was later advanced 600 feet to the Queen of the Mountains vein Drifts were driven on this vein both northward and southward The south drift extended to the Gem, or South Carolina, claim, which adjoins the Moulton claim at the north (17) About $45,000 was expended in development up to 1897, but only six carloads of sorted ore were shipped, the last carload netting only $200 (29)

Gold values in the sorted ore shipped were somewhat higher than in ore from other nearby mines One shipment yielded $15 gold and 10 ounces silver a ton (17) Production records for years previous to 1904 are not available Production from 1904 to 1917, inclusive, is reported to have been 107 tons of sorted ore, from which 11 87 ounces gold, 4,387 ounces silver, and 27,938 pounds lead were recovered (14)

The Ingersoll vein occurs in gneiss, Pinto diorite, and minette, it is reported to have been generally narrow and low-grade It strikes N 10° to 20° E At the southern end the dip is to the west, at the north the dip ranges 60° to 80° SE The Ingersoll vein contained a narrow band of spar dotted with galena, sphalerite, pyrite, and small amounts of silver sulfides, it averaged less than 6 ounces silver a ton (29) However, it contained some small higher-grade steaks Another vein 2 feet in width, which was cut by the west crosscut about 150 feet from the main vein, contained bunches of ore but averaged low in silver (29)

The main Ingersoll vein may be the northward extension of the Moulton vein or a split from it, or it may be the northward extension of one of the veins cut by the Rochester adit on the Unity claim of the Moulton group The downward extensions of the Ingersoll veins and the Gem-Queen of the Mountains vein might be developed at a considerably lower altitude by extending the Compromise adit northward through the Moulton fault and under the old Ingersoll workings The veins also might be developed at a much greater depth by extending the 300 shaft level of the Moulton mine northward under the Ingersoll claim and then crosscutting

When visited in 1949, both adits on the Ingersoll claim were inaccessible

Rock Creek (Ag-Pb-7r)

The Rock Creek claim adjoins the Ingersoll claim at the east and the Lizzie claim at the south It was located August 27, 1888, by Patrick Boyle The claim was purchased later for R E Paine, 50 Congress Street, Boston, Mass It now is owned by Paine's heirs, for whom H L Maury, Butte, Mont , is agent

The claim was worked extensively in the 1890's A small amount of ore was produced, but no production records are available Several veins were exposed by crosscuts and drifts east from the main adit, which followed the main vein for several hundred feet (17) The main vein is 1 to 3 feet wide, it strikes N 10° W and dips 45° to 70° SW One ore shoot about 80 feet long was found about 200 feet in from the main adit portal According to Jesse L Maury, who examined the mine in 1929, the ore in this shoot averages 38 inches in width It contains an average of 2 ounces silver a ton, 2 6 percent lead, and 3 9 percent zinc The other veins, explored from crosscuts driven east from the main adit, failed to disclose ore of commercial grade These veins have strikes ranging from N 15° E to N 45° E , they dip 70° to 90° NW Ore mined from the shoots on the main vein, after careful sorting, is reported to have yielded 80 ounces or more of silver a ton and 16 to 18 percent lead (17) The veins traverse gneiss, Pinto diorite, and amphibolite, in some places following along the diorite-gneiss contact The main adit was inaccessible when visited in 1949 owing to caving at the portal

Lizzie (Ag-Pb-Zn)

The Lizzie claim is near the head of Rock Creek about three-fourths of a mile east of the north end of the main street of the town of Neihart

The claim was located August 31, 1881, by Michael Powers, one of the first discoverers of veins in the Neihart area It still is owned by Powers' heirs, Mrs Bertha Powers, Neihart, Mont , one-third, Mrs H W Powers, Conrad, Mont , one-third, and Mrs John Powers, address unknown, one-third

Early operations by the owner continued intermittently until 1897 Since then lessees have operated sporadically The last work on the claim was done in 1943 by W J Powers, Neihart, Mont

Records of production prior to 1907 are not available According to Weed, the first ore shipped was from the discovery shaft, the 15-ton shipment netted the owner $786 It was estimated that about $5,000 worth of ore had been produced up to 1897 (29) Production from 1907 to 1943, inclusive, is reported to have been 347 tons of ore, from which 17 42 ounces gold, 30,458 ounces silver, 130 pounds copper, and 99,861 pounds lead were recovered (14)

At least four veins occur within the claim Surface cuts indicate the presence of several other veins Two of the veins have been developed to shallow depths by six adits The lower No 1 adit, near the south end of the claim, is 200 feet long The No 2 adit, on a parallel vein, is reported by W J Powers to be 350 to 400 feet long Two short crosscuts were driven east and west from this adit for distances of 15 and 20 feet, respectively The faces of both crosscuts are in altered vein material Some low-grade ore occurred in small lenses in this adit

The No 3 adit, driven on the same vein but about 145 feet higher, is approximately 100 feet in length It was started in Pinto diorite 30 feet east of a large mass of red, feldspathic gneiss A wide vein is reported to have been followed in this adit The strike of the veins in the No 2 and No 3 adits is N 10° E , they dip 75° to 80° NW No 4 adit, 100 feet above No 3, is reported to be about 120 feet long It was driven on a vein about 4-1/2 feet wide containing an oxidized, honeycombed quartz streak about 1 foot in width A short shoot of ore was found near the portal and was mined to the surface, where it merged with a vein of solid quartz 8 inches wide A shaft was sunk on this narrow quartz vein to a depth of 20 feet Both veins are in altered gray gneiss They strike N 10° to 15° E The wider vein dips 75° NW The 8-inch vein is nearly vertical

No 5 adit is reported by Powers to be approximately 100 feet in length A small amount of ore was found by this adit It is 35 feet higher than the No 4 adit and apparently was driven on the same vein No 6 adit is 120 feet higher than No 5 It is about 120 feet long The vein followed by this adit strikes N 6° E and dips 43° to 45° NW It is in gray altered gneiss for most of the length of the adit, but near the face Pinto diorite occurs on the hanging wall side A band of quartz about 1 inch wide follows the footwall A small amount of silver sulfide minerals can be seen in and alongside of this narrow quartz band

The discovery shaft, now caved, is near the top of the main ridge about 45 feet above and 125 feet north of the No 6 adit portal It was sunk on an oxidized quartz vein in gray gneiss This vein is about 1 foot wide and dips about 75° NW

Other large cuts and pits about 100 feet to the east indicate where the oxidized outcrops of other veins were prospected According to Powers, a small amount of high-grade silver ore was mined from these cuts Most of the ore shipped was mined from the No 2 and No 3 adits

Veins similar to those on the Lizzie claim have been prospected on the Crandall claim adjoining at the north Some ore was produced from shallow workings Several veins have been drifted on on the Rock Creek claim adjoining at the south

When visited in 1949, the No 4 adit was accessible for a short distance beyond the portal No 6 adit was accessible to its face The other adits were caved at their portals

Champion "B (Ag-Pb-Zn)

The Champion "B' claim adjoins the Lizzie claim at the east and the Dacotah claim at the west It is about 1 mile northeast of Neihart The claim was located in the 1880's Little could be learned of its early history Marvin E Corkill of White Sulphur Springs, Mont , is the present owner

Production data for years prior to 1919 are not available Production from 1919 to 1946, inclusive, is reported to have been 123 tons of ore, from which were recovered 13 76 ounces gold, 4,070 ounces silver, 31,474 pounds lead, and 6 574 pounds zinc (14) One carload, or 24 tons, of this ore was shipped to the Midvale, Utah, concentrator in 1943 From this shipment, 2 00 ounces gold, 415 ounces silver, 6,251 pounds lead, and 5,800 pounds zinc were recovered (14)

Two parallel veins traverse Pinto diorite From one adit a 30-foot winze is reported to have been sunk on a vein 3 feet wide (17) According to Sam Williams, Belt Mont , the east vein averaged about 8 or 10 inches in width and dipped steeply to the east toward the Dacotah The strike of both veins is about the same as those in the Lizzie claim Vein material on the dump of the middle of three adits indicates the vein was mainly honeycombed quartz containing considerable galena, sphalerite, and pyrite Limonite, cerussite, and probably smithsonite also may be present A sample of ore taken from one of the dumps by Jesse L Maury is reported to have assayed 23 4 ounces silver, 10 1 percent lead, and 6 8 percent zinc (17)

When visited in 1949, all of the adits were inaccessible

Commonwealth, Spotted, and Lucky Strike (Au-Ag-Pb)

The Commonwealth and Spotted claims are high on the east slope of the ridge between Snow Creek and Rock Creek, about 1-1/2 miles northeast of Neihart The Commonwealth adjoins the Silver Belt claim at the east The Spotted adjoins the Commonwealth at the north The unpatented Lucky Strike claim is north of the Spotted claim

Little historical information could be obtained At one time the Commonwealth and Spotted veins were developed by the Red Star Mines Co In 1935 the Commonwealth and Lucky Strike veins were prospected (17) The Commonwealth and Spotted claims were purchased at tax sale by the present owners, J J Steward, Spokane, Wash , and Mrs Victor G Leich Owners of the Lucky Strike claim are unknown

According to Schafer (17), the Commonwealth vein was developed by two adits, the parallel Lucky Strike vein by one adit No information is available regarding the development on the Spotted claim Both veins are in Pinto diorite They range from a few inches to 2 feet in width, widening locally at intersections or splits The ore mineral is chiefly galena with small amounts of sphalerite and silver sulfides in a gangue of carbonates and quartz (17)

No data on production previous to 1921 are available Apparently because of the various lessees and differing leases, production records since 1921 are not available for each claim but have been combined, as follows Production from the Lucky Strike and Spotted claims, 1921 to 1941, inclusive, is reported to have been 132 tons of ore, from which were recovered 119 61 ounces gold, 9,604 ounces silver, 494 pounds copper, and 2,159 pounds lead (14) Production from the Commonwealth and Spotted claims, 1935 to 1940, inclusive, is reported to have been 74 tons of ore, from which 35 5 ounces gold, 4,322 ounces silver, 114 pounds copper, and 2,429 pounds lead were recovered (14)

The mine workings were inaccessible in 1949

Cumberland (Ag-Pb-Zn)

The Cumberland claim adjoins the Equator claim at the east, it lies a short distance west of the Moulton claim The claim was located in the early 1880's by Duncan McCowan, later, it was patented The Neihart Cumberland Mining Co (Mrs Eliza Booth, Great Falls, Mont) is the present owner

Development consists of a 400-foot adit, now inaccessible. The vein occurs in pink gneiss (29). It probably is the same vein from which some silver-lead ore was mined on the Peabody claim, which adjoins the Cumberland claim at the north. Some high-grade ore is reported to have been mined from the Cumberland claim during McCowan's ownership. Later, it was worked at intervals by lessees. Nothing has been done on the claim in recent years.

Peabody (Ag-Pb)

The Peabody claim lies between the Galt claim and the Queen of the Mountains claim. It was located March 26, 1888, by Henry G. Klenze et al. The property now is owned by O. F. Wadsworth, Jr., c/o Edward Byrnes, Boston, Mass.

The Peabody vein is in pink gneiss. It is reported to be the northward extension of a vein on the Cumberland claim, which adjoins at the south.

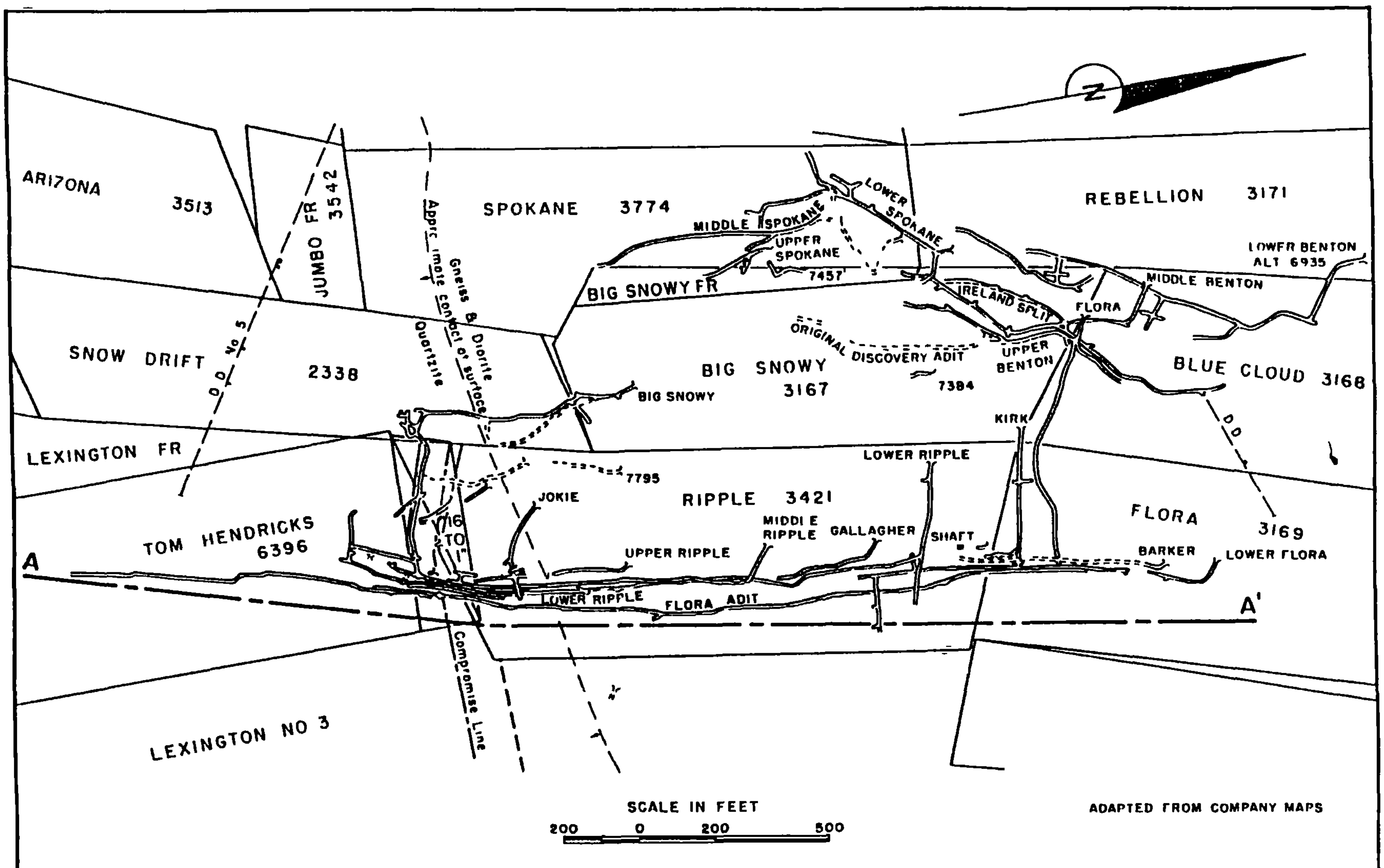
Production data for years previous to 1922 are not available. Production for 1922 to 1940, inclusive, is reported to have been 152 tons of ore, from which 1.0 ounce gold, 10,433 ounces silver, and 26,136 pounds lead were recovered (14).

All mine workings are reported to be inaccessible.

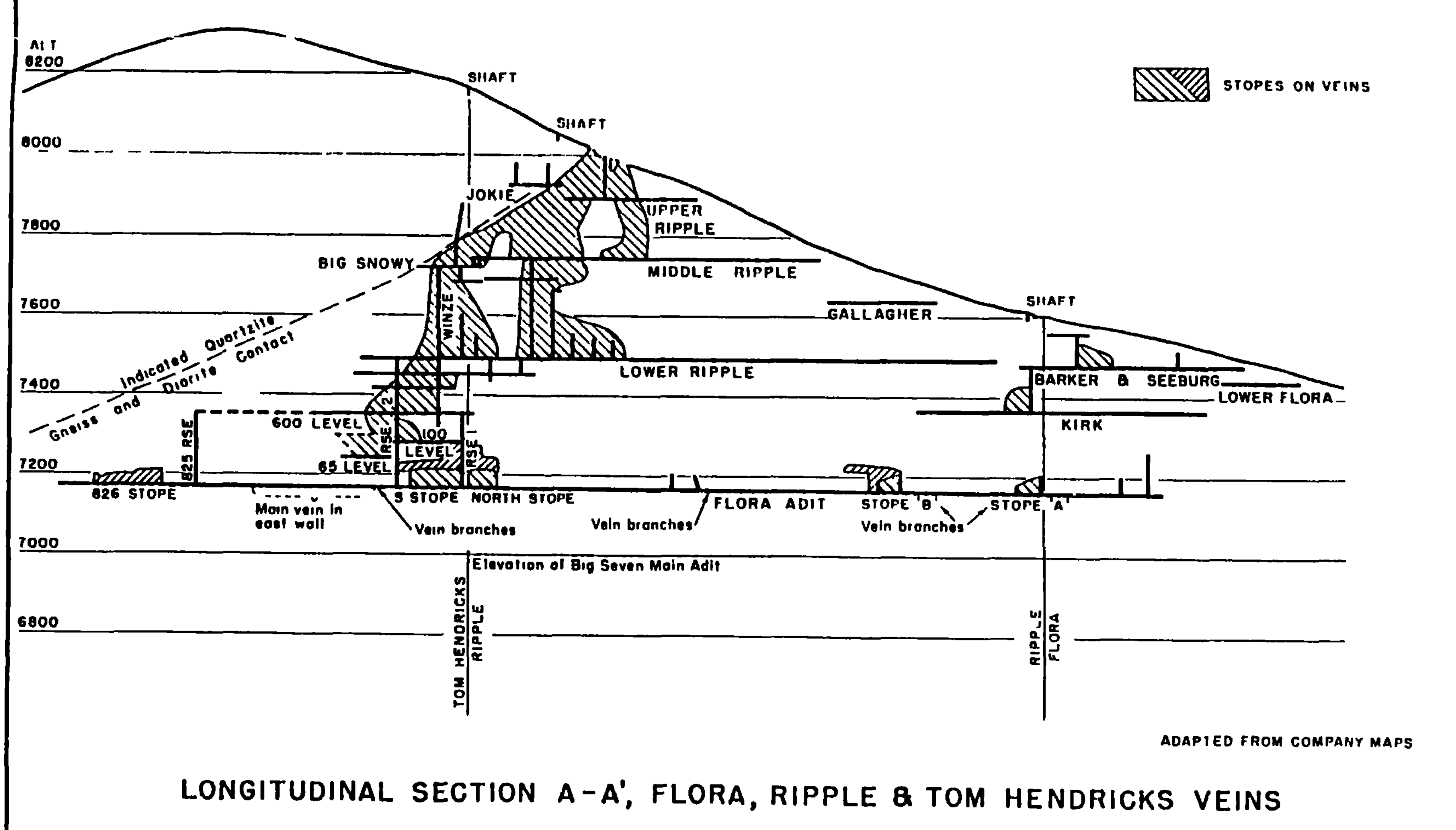
Benton (Ag-Pb-Zn)

The Benton group of 15 patented claims is at the head of Snow Creek about 1-1/2 to 2 miles east of Neihart. The group is comprised mainly of claims located from 1886 to 1890 and later acquired by the Benton Group Mining Co. Ten of the claims, Big Snowy, Big Snowy Fraction, Flora, Spokane, Laura, Last Chance, Blue Cloud, Puck, Loo Loo, and Rebellion, are owned entirely by the company. The Arizona and Union claims are owned by the Spencer, Mayn, and Heitman heirs. Ownership of the other claims is divided; the Benton Group Mining Co. has a 19/30 interest in the Sixteen-to-One and the Tom Hendricks claims and a 1/20 interest in the Snowdrift claim. The Spencer, Mayn, and Heitman heirs own the remaining interests. C. B. Power, Helena, Mont., is president of the Benton Group Mining Co. G. K. Spencer, White Sulphur Springs, Mont., is trustee for the Spencer, Mayn, and Heitman heirs.

First operations on the claims were conducted by their owners and by lessees. The principal workings were at the Big Snowy mine, which was owned and operated in 1891 by the Montana Mining Co. (9). Considerable development was done in 1891 and 1892. The ore mined was shipped to the Helena Sampling Works (10). Veins on the adjoining Blue Cloud and Spokane claims also were developed. The Big Snowy Mining Co. owned and operated the Big Snowy mine in 1900 (3). During several following years, good ore was produced by several different lessees. By 1906 control of most of the claims had been acquired by the Benton Group Mining Co., of which T. C. Power of Helena, Mont., was president (23). All mining since 1906 has been done by lessees (17). Operations were conducted intermittently by Barker Brothers, D. L. Ledbetter, and C. L. Kirk, and in more recent years by the Montana Leasing Co., Montana Silver Queen Mining Co., Lexington Mining Co., and Lexington Silver-Lead Mines, Inc.



PLAN OF BENTON GROUP & RIPPLE MINE WORKINGS



LONGITUDINAL SECTION A-A', FLORA, RIPPLE & TOM HENDRICKS VEINS

Figure 8. - Plan and section, Benton group and Ripple mines, Montana district, Cascade County, Mont.

Records of production for the years prior to 1905 are not available. It is reported that up to 1898 production from the Benton (Big Snowy) mine (fig. 8) had a value of more than \$400,000 (29) (17). Production of the Benton group from 1905 to 1948, inclusive, is reported to have been 54,713 tons of ore, from which 1,033.47 ounces gold, 640,935 ounces silver, 9,407 pounds copper, 1,128,733 pounds lead, and 333,357 pounds zinc were recovered (14).

The Big Snowy veins were developed by four main adits ranging in length from about 500 feet to more than 1,600 feet (fig. 8). Another adit at the southern end of the claim was about 600 feet long. From this adit, a crosscut was driven through the Sixteen-to-One claim to the vein that traverses the Tom Hendricks, Ripple, and Flora claims. Several adits also were driven on the Spokane, Blue Cloud, and Flora claims, where development, including raises and winzes, totals several thousand feet.

According to Weed (29), the vein developed in the upper Big Snowy adit traversed both Pinto diorite and quartzose gneiss. In places the vein followed the contact of these formations. The vein material was a bluish, decomposed, brecciated gneiss. The walls were soft and highly altered. The ore minerals in the upper adit were confined mainly to a narrow band or streak consisting of loosely compacted sulfides with native silver, usually only a few inches wide but very rich. In the lower or main adit the vein was 3 to 6 feet wide but narrowed appreciably in the diorite. In the lower adit the ore occurred mainly in bunches or small lenses (29)(17). The ore was highly siliceous; it contained abundant pyrite, with galena, sphalerite, silver sulfides, and some gold. Galena and sphalerite increased at depth (17).

The gold content of the ore was higher than that in the ores from most of the mines in the Neihart district. For this reason the mine was profitably operated from 1892 to 1896 despite the low prices of silver and lead (29).

For several years a gravity-type mill was operated at the property. The mill was dismantled many years ago. In later years most of the ore was milled in the nearby Lexington 150-ton flotation plant.

The Lexington Silver-Lead Mines, Inc., mined a part of the Tom Hendricks vein through the Big Snowy adit and treated material from the Big Snowy dump. This company ceased operating in April 1948. The Benton group has been inactive since that time. When visited in 1949, most of the old adits were caved or otherwise inaccessible.

Big Seven (Ag-Pb-Zn)

The Big Seven mine is in upper Snow Creek Valley about 2 miles northeast of Neihart. The mine workings are mainly on the Emmett, Silver Horn, Red Horse, Jennie Whipple, and Longview claims, which are part of a group of 11 patented and 2 unpatented claims known as the Big Seven group. These claims are to the west of the Benton Group Mining Co. claims.

Most of the claims were located in the early 1890's. The Emmett was located January 1, 1891, by the Big Seven Mining Co., which operated the mine for several years. It was operated later by D. L. S. Barker and by the Montana Silver Queen Mining Co. This company, incorporated in 1935, changed its name and combined with the Lexington Mining Co. in June 1940 (22-1940). The Lexington Mining Co. operated the Big Seven mine until July 1943 and remodeled and enlarged the 100-ton bulk flotation mill, formerly constructed and operated by the Montana Silver Queen Mining Co., to a 150-ton selective flotation plant. The mine and mill then were leased to the Montana Leasing Co. Operations under this leasing company continued until December 1, 1946, when the Lexington Silver-Lead Mines, Inc., acquired control of the Big Seven group of claims and the mill (26). This company, with offices in Spokane, Wash., and Washington, D. C., now owns 21 patented and several unpatented claims. Both the Big Seven group and the Lexington group are included in these holdings (fig. 9).

The Big Seven mine has been developed by four main adits. The three upper adits were driven southward along the vein. The Big Seven, or lowest adit, was driven as a crosscut for about 800 feet and then as a drift on the vein for about 2,900 feet (fig. 9). A 200-foot winze was sunk from this drift at a point about 1,500 feet in from the crosscut. About 700 feet of drifting was done on the 180-foot winze level. No stoping was done from this winze level. A block of ore about 300 feet long, however, was mined to a depth of about 50 feet below the Big Seven adit level in one of the ore shoots to the north of the 200-foot winze. Total development, including many sub-levels between the Glover and the Big Seven adits, aggregates many thousands of feet.

According to Weed (29), the vein followed a well-defined fissure traversing both gneiss and Pinto diorite. It penetrated the Neihart quartzite, which covers the gneiss and diorite on the southern claims. In this locality the vein is about 7 feet wide. It strikes N. 20° E. and is nearly vertical. The vein filling is quartz or quartzite partly impregnated with ore minerals. It often contains considerable amounts of molybdenite. Some of the oxidized ore was very rich but averaged 20 to 50 ounces silver and \$5 to \$10 in gold a ton.

North of the quartzite the vein strikes about N. 30° to 40° E. and dips about 75° NW. It averages about 5 to 6 feet in width in the gneiss. In the Pinto diorite it ranges from 3 inches to 2-1/2 feet in width. Vein filling consists mainly of altered silicified gneiss or diorite in which the ore minerals occur in bands or lenses. Sometimes two bands or pay streaks were present, usually along the walls to which they generally were frozen. These bands ranged from narrow streaks to 2 feet in width (29). According to Charles Fors, Neihart, Mont., bands to 3 feet in width containing ruby silver were mined in the stopes above the 19 and 21 intermediate drifts. The full width of the vein in these stopes was about 12 feet; the hanging wall was fractured and very loose.

The ore mined before 1897 contained much silver and gold. The ore mined in August 1897 is reported to have contained 100 to 500 ounces silver and \$50 in gold a ton. At that time two to three carloads of ore containing about 300 ounces silver a ton were obtained from development (29).

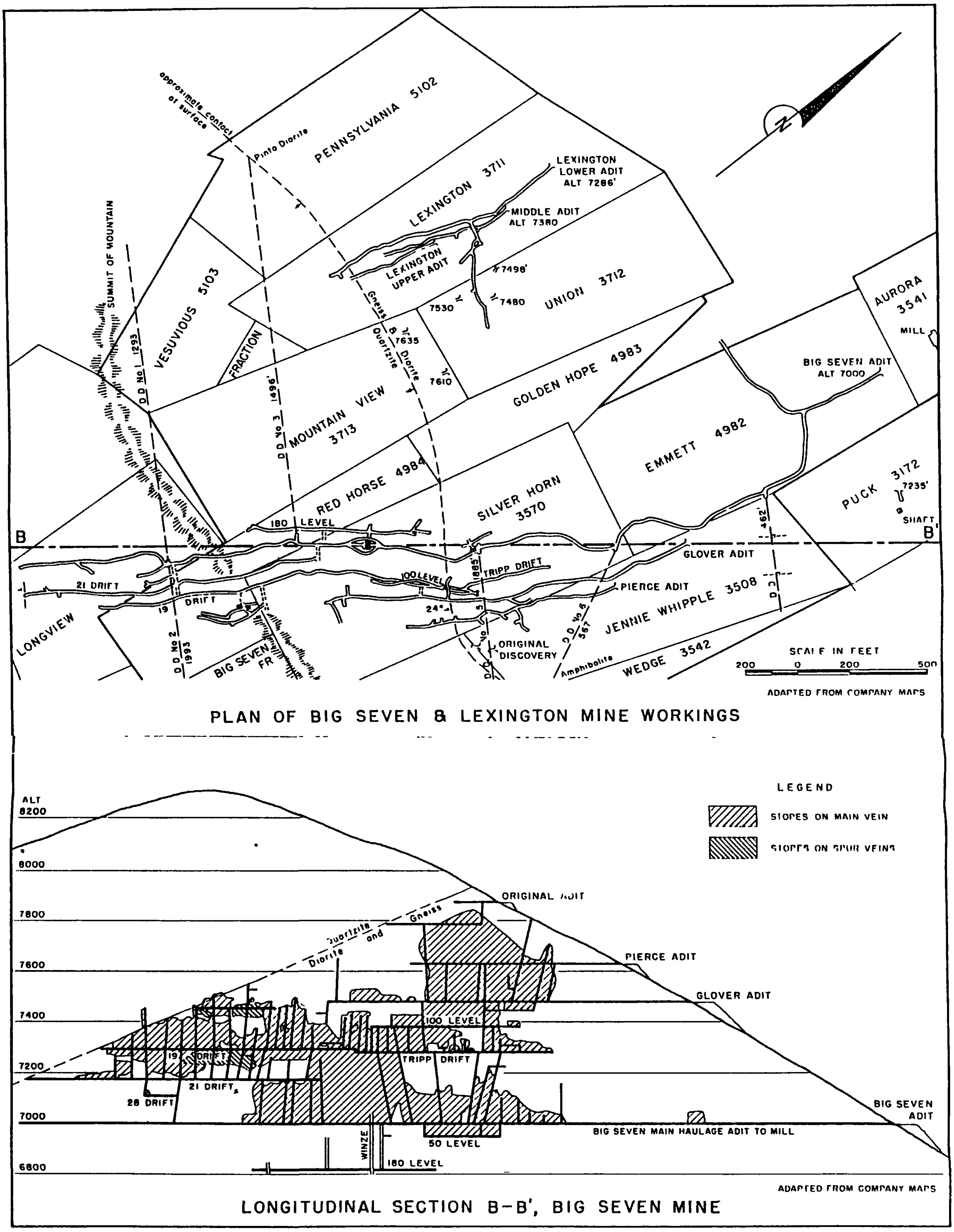


Figure 9. - Plan and section, Big Seven mine, Montana district, Cascade County, Mont.

PLEASE RETURN

Records of production for the years previous to 1902 are not available. Production from 1902 to 1943, inclusive, is reported to have been 143,274 tons of ore, from which 17,538.86 ounces gold, 2,306,353 ounces silver, 63,022 pounds copper, and 523,369 pounds lead were recovered (14).

The ore minerals in the upper parts of the mine were mainly silver sulfides. Lead and zinc minerals were present in small amounts only. In the lower levels, the ore contained several percent of both lead and zinc. The Sulfide minerals were chiefly pyrite, galena, sphalerite, proustite, and perceite. Polybasite probably was present. Small amounts of tetrahedrite (or freibergite), chalcopyrite, molybdenite, and arsenopyrite were obserbed microscopically (17).

Two ore shoots, each about 600 feet long, were developed on the Big Seven adit level; they were prospected from a 180-foot winze from this adit level for a length of over 700 feet. Long adits driven at lower elevations from other properties would develop the veins below the present workings.

When visited in August 1949, all of the upper adits were caved or otherwise inaccessible. Snow drifts covered the Big Seven adit portal. It was reported later that this adit had been reopened and drained during the fall of 1949 and had been repaired nearly to the winze.

Lexington (Ag-Pb)

The Lexington group of five patented claims is northwest of the Big Seven group. The Lexington, Union, and Mountain View claims were located in August 1891 by the Lexington Consolidated Mining Co. The Pennsylvania and Vesuvius claims were located by Daniel Lenny, et al, in 1891 and 1892; they were acquired later by the Lexington Consolidated Mining Co. This company did not operate, but leased to various lessees. In 1905 the claims were reported to be owned by Allan Pierse and W. H. Harrison (23). Control was obtained later by a resident of Choteau, Mont., who deeded it to the Protestant Hospital in Great Falls, Mont. Subsequently, the claims were owned by the Montana Silver Queen Mining Co., then by the Lexington Mining Co., and then by the Lexington Silver Lead Mines, Inc., the present owners.

Principal mine workings are on the Lexington claim, where the Lexington vein has been developed mainly by three adits ranging from about 360 feet to nearly 1,000 feet in length. The strike of the vein is about N. 20° E.; its dip is about 80 NW. (fig. 9).

According to an unpublished Bureau of Mines report, the vein is about 3 feet wide. The vein occurs in Pinto diorite and gneiss; it extends southward under the Neihart quartzite, which overlies the southern end of the Lexington claim.

No production records are available. It is reported, however, that a considerable tonnage of silver-lead ore was mined. The workings were reported inaccessible in 1949.

Ripple (Ag-Pb-Zn)

The Ripple mine is in upper Snow Creek Valley about 2 miles northeast of Neihart. It is between the Flora and the Tom Hendricks claims, which are owned by the Benton Group Mining Co., et al.

The Ripple claim was located in May 1883 by Andrew J. Briggs. It was operated by the Ripple Mining Co. in 1905 and 1906, when 200 to 300 tons of high-grade ore was mined monthly (23). An adit crosscut had cut the vein about 200 feet below the upper workings before 1910 (25). The mine was owned and operated by Barker Brothers during 1911-12 (26). Later, an operating company was formed. Dave Barker's half interest was purchased by Robert A. Nathan, Great Falls, Mont. The remaining interests are owned by Matthew H. Brown, William Brown, and Charles Brown, all of Great Falls, Mont., and Mrs. Hall, Spokane, Wash.

Various lessees have operated the property. These included C. L. Kirk, the Montana Leasing Co., the Lexington Mining Co., and the Lexington Silver-Lead Mines, Inc. Operations on the Ripple claim were nearly continuous from 1906 to 1924. The mine was idle from 1925 to 1939. In 1939 C. L. Kirk conducted a small operation. The property was idle again in 1941 and 1942. In 1943 several thousand tons of dump material were milled by the Montana Leasing Co. (22-1943). Later operations by the Lexington Mining Co. and the Lexington Silver-Lead Mines, Inc., continued until April 1948, when all mining and milling at the nearby Lexington 150-ton selective flotation plant ceased. No work has been done on the property during the past year.

No production records previous to 1906 are available. Production from 1906 to 1945, inclusive, is reported to have been 25,634 tons of ore, which yielded 1,144.54 ounces gold, 523,857 ounces silver, 3,805 pounds copper, 749,937 pounds lead, and 7,235 pounds zinc (14). Production during 1946 and up to April 7, 1947, amounted to 974.22 tons of ore and concentrates, which, according to smelter settlement data provided by R. A. Nathan, had a gross value of $105,815.68.

The mine has been developed by four main adits and by two short adits on the north end of the claim (fig. 8). One of the short adits was driven southward into the Ripple claim from the Flora by C. L. Kirk in 1939-40. A short ore shoot was developed and mined. The other adits developed the ore shoot, which extends downward to the south under the Neihart quartzite. Three of the adits were extended into the Tom Hendricks claim and served to develop the vein on that claim.

The vein, traversing Pinto diorite and quartzose gneiss, strikes about N. 20° E. and dips steeply to the northwest. It averages 2 to 4 feet in width over most of the length of the claim. The vein material is mainly crushed, altered gneiss or diorite and quartz. The sulfide minerals consist mainly of galena, sphalerite, and pyrite with a small amount of chalcopyrite with which silver sulfides are intimately associated. These minerals occurred both as bands and as disseminations in the vein material. During the earlier operations, only the richer parts of the vein were mined. However, much of the ore mined was sorted out and discarded to avoid excessive penalties for the contained zinc. Some of the dump material and gob filling was milled in later years. Much gob material still remains in the old stopes.

Several ore shoots were developed from the lower, or Flora, adit, especially at splits or branchings of the main vein. No ore has been mined below this adit level. Deep development of the Flora-Ripple-Tom Hendricks vein and its southward continuity under the quartzite could be accomplished by driving a low-level adit from the south side of Neihart Baldy Mountain.

When visited in 1949, the upper adits were closed by caving. The Flora adit was closed at the portal by snow and ice.

Tom Hendricks (Ag-Pb-Zn)

The Tom Hendricks claim is one of the Benton group. It is south of the other Benton group claims and in the saddle between Neihart Baldy and Long Baldy Mountains. It is about 1-3/4 miles northeast of the town of Neihart.

The claim was located January 1, 1886, by J. T. Armington, et al. A 19/30 interest in the claim was acquired later by the Benton Group Mining Co.; the remaining 11/30 interest is owned by Spencer, Mayn, and Heitman heirs, White Sulphur Springs, Mont. (see Benton group).

Little can be learned of its early history. It has been mined by D. L. Ledbetter, J. J. Stewart, the Lexington Mining Co., the Montana Leasing Co., and, after December 1, 1946, by the Lexington Silver-Lead Mines, Inc. (22-1946). This latter company operated the mine for James A. Allen and F. C. Keane, who leased it from the owners in February 1945. Operations by this company terminated April 23, 1948.

Production records for the Tom Hendricks mine are not available. Because of the many leasing operations on the Benton group of claims, production from the Tom Hendricks mine has not been segregated. It is known, however, that a large part of the production from the Benton group between 1944 and 1948 was made from the Tom Hendricks claim. G. K. Spencer has estimated the net value of ore and concentrates shipped during those years at about $243,000. Ledbetter is reported to have produced a considerable amount of rich ore during the time he operated the mine. J. J. Stewart is reported to have produced about $60,000 worth of ore (17).

The Tom Hendricks main vein has been developed by three main adit drifts, all of them driven from other properties (fig. 8). The upper drift was driven a short distance on the vein from a crosscut driven eastward from the Big Snowy adit. A winze was sunk on the vein from this level. This winze connected with the Lower Ripple adit drift, which was extended into the Tom Hendricks claim for several hundred feet. Later, the adit drift from the Flora claim was extended south through the Ripple claim, the fractional Sixteen-to-One claim, and into the Tom Hendricks claim for about 1,000 feet. Numerous raises connect the lower adit with the upper workings.

The main vein and several other veins on which some development was done traverse light-colored gneiss and Pinto diorite on the Tom Hendricks claim. These formations are overlain by the Neihart quartzite, which dips 18° to 30° toward the south. In places the veins extend for short distance into the quartzite. Some secondarily enriched ore has been mined from some of these veins in the quartzite, which, however, soon become narrow and unproductive. The main ore shoot on the main vein terminates at the contact of the quartzite capping; it has been developed on all levels above the lowest, or Flora, adit level, where it was drifted on for several hundred feet. Another vein, apparently a branch of the main vein, also was developed near the north end line of the Tom Hendricks claim.

The main vein strikes about N. 20° E. Above the Lower Ripple adit level it dips 75° to 85° NW; below that level it is nearly vertical. According to information obtained from old maps, the vein averaged 3 to 4-1/2 feet in width. The grade of the ore ranged from 4 ounces to as much as 190 ounces of silver a ton. Lead content ranged from 1.6 to more than 4 percent. Zinc content in the upper levels generally was low but increased at depth.

The last company operating the mine at one time considered driving a 2,000-foot crosscut from the main haulage adit on the Big Seven mine in order to attain an additional depth of 155 feet on the main Tom Hendricks vein.

Cornucopia (Ag-Pb-Zn-Au)

The Cornucopia claim is one of a group of 12 patented claims on the northeast slope of Long Baldy Mountain near the headwaters of the east fork of Snow Creek, about 3 miles southeast of Neihart. One of the claims, the Ontario, was located in August 1885; the others were located by the Cornucopia Mining Co. in 1891.

Development consists mainly of three adit drifts and a 300-foot, 2-compartment shaft with levels at 150 and 300 feet. Most of this development was done in 1891 and 1892 (9) (10). The mine was operated by the Cornucopia Mining Co. for several years, but only a few carloads of ore was shipped (17). In later years the mine was operated intermittently by lessees. The last work was done by Charles Mackey, who advanced one of the adit drifts several hundred feet toward the shaft. Present ownership is divided: H. L. Maury and five sons of Senator James E. Murray hold a three-fourths interest; A. G. Shone, Butte, Mont., one-eighth; and J. J. Stewart, Spokane, Wash., one-eighth. No production records are available.

The vein, as exposed at the portal of one of the adits, is composed of about 12 inches of rusty quartz with about 2 feet of altered, banded Pinto diorite on each side. It strikes N. 13° E. and dips 78° W. Material on the dump indicates the vein traverses gneiss as well as Pinto diorite. Elsewhere the vein is reported to have contained a narrow stringer of sulfide minerals 1 to 6 inches in width. The dump material shows the presence of oxides and carbonates as well as galena, sphalerite, pyrite, and small amounts of chalcopyrite.

A Bureau of Mines sample selected from a small pile of sorted ore found on the dump of the adit extended by Mackey assayed 1.46 ounces gold, 53.5 ounces silver, 5.7 percent lead, 13.8 percent zinc, 0.14 percent copper, 0.10 percent antimony, and 0.10 percent cadmium.

According to Charles Fors, Neihart, Mont., very little ore was mined, as it contained too much zinc to permit its profitable mining and shipment at that time.

When visited in 1949, the shaft had collapsed and the shaft house had fallen into the resulting depression. The Mackey adit was inaccessible owing to caving at the portal.

Black Diamond (Ag-Pb-Zn)

The Black Diamond group of five patented claims in on the ridge between the upper forks of Snow Creek about 2 miles up Snow Creek from its junction with Carpenter Creek.

The biennial report of the Montana Inspector of Mines for 1909-10 (25) states that 1,100 feet of adits had been driven and several veins containing concentrating ore had been intersected. At that time the property was owned and operated by the Black Diamond Mining Co. A 50-ton gravity-type mill was constructed in 1909-10 and operated for 2 or 3 years. The group now is owned by Ralph G. Parker, Great Falls, Mont. No production data are available.

Material in the dumps near the old mill indicates that the adit penetrated gneiss and Pinto diorite. The dump at a caved shaft on the ridge above the adit is composed of coarse-grained porphyry.

A Bureau of Mines sample of sulfide ore found in the ore bin at the old mill assayed 0.15 ounce gold, 22.7 ounces silver, 5.4 percent lead, less than 0.05 percent zinc, 0.1 percent antimony, and 0.05 percent cadmium.

When visited in 1949, the main adit was closed by a cave at the portal; other workings also were inaccessible.

Lexington No. 2 (Au-FeS_2)

The Lexington No. 2 claim, unsurveyed, adjoins the Black Diamond group at the northwest. It is about 1-1/2 miles up Snow Creek from its junction with Carpenter Creek. The claim was located by the Lexington Mining Co.

A vein in altered gray gneiss was cut by an adit about 20 feet in from its portal and drifted on for a short distance to the south. These workings now are inaccessible owing to caving at the adit portal. The dump contains large fragments of iron pyrite with a small amount of quartz. The iron pyrite is coarsely crystalline and is reported to contain a little gold. Some arsenopyrite may be present. Virtually no oxidation was noticeable. The property is referred to locally as the "iron" mine.

I.X.L. - Eureka (Au-Ag-Pb)

The I.X.L. and Eureka claims are on the north slope of the main ridge between Rock Creek and Snow Creek, about 2 miles northeast of Neihart. The claims were located in the 1880's and were worked extensively before 1897 by different owners and lessees. About 1905 or 1906 a 10-stamp mill and cyanide plant were constructed on Snow Creek about 1 mile up from its junction with Carpenter Creek. This plant was operated for a short time only. Later operations were conducted intermittently by lessees. The property now is owned by Lee M. Ford, et al, Sun River, Mont.

No data on production previous to 1906 are available. Production from 1906 to 1932, inclusive, is reported to have been 1,188 tons of ore, from which were recovered 297.22 ounces gold, 11,112 ounces silver, and 2.807 pounds lead (14). According to Alex Harrison, Great Falls, Mont., only one small bar of silver bullion was produced when the cyanide plant was operated.

According to Weed (29), the ore occurred in disseminated deposits in fractured Snow Creek porphyry. Development was by a 250-foot shaft with two levels, several adits, and numerous surface pits and trenches. The ore minerals were mainly sooty silver sulfides with manganese oxides and some native silver. Some ore contained a considerable amount of gold. According to Weed, the ore did not extend deeper than 90 feet below the surface.

All of the old workings were inaccessible when visited in 1949.

Mountain Chief (Pb-Zn-Ag)

The Mountain Chief mine is on the north slope and at the top of the main ridge south of Carpenter Creek, about three-fourths mile northeast of the Star group of claims.

The claim was located August 8, 1881. It was purchased from the original owners in 1884 by the Hudson Mining Co. for $18,000 (29). Development was begun immediately. The first ores mined were very high-grade. According to Weed (29), over $10,000 worth of ore was extracted during the sinking of the first 20 feet of the south shaft near the top of the ridge. A concentrator and a small smelter were constructed. The rich ore did not continue to depth. The lower-grade ore was not concentrated or smelted successfully. When the ore above the upper adits was depleted in 1890, all operations ceased. In 1893 the property was owned and operated by Sampson Bros., who later abandoned it (18). In 1939 it was purchased for taxes by J. C. Barker and Duane Hervig. It now is owned by Mrs. Eulalie B. Toole and Duane Hervig, Great Falls, Mont. No production data are available.

Development consists of four shafts, the deepest being 310 feet, and three or more adits (16). According to Weed (29), the upper drift adit was 700 feet long. It cut masses of feldspar gneiss included in the Pinto diorite. In places the vein follows the contact of these rocks with diorite on the hanging wall and gneiss on the footwall. About 500 feet in from the portal the vein crosses a porphyry dike. The vein ranges in width from 30 to 40 inches. A crosscut driven into the footwall from this adit cuts two veins, one at 33 feet and the other at 43 feet. The first vein, about 3 feet wide, was barren where cut. The second vein, about 2 feet wide, contained a band of good ore minerals.

A second adit, about 900 feet above Carpenter Creek, is about 1,000 feet long. The vein exposed in this adit is but a foot or so wide where it traverses Pinto diorite for several hundred feet. About 600 feet in from the portal the vein widens to about 7 feet. It contains an ore shoot that was stoped to the upper adit and to the surface (29). At the surface this vein is about 2-1/2 feet wide; it strikes N. 4° W. and dips about 80° to 85° SW.

A lower adit, nearly 1,700 feet long, was driven southward from the north end of the "88" claim, which adjoins the Mountain Chief at the northwest. At that time the "88" claim also was owned by the Hudson Mining Co. No important ore bodies were encountered by this adit, although a vein containing low-grade ore was intersected near the face (17). According to W. B. Carroll, Great Falls, Mont., the adit was driven at a slight angle with the Mountain View vein. When operations were suspended in 1890, the main vein had not been reached. Material on the "88" dump indicates the adit penetrated Pinto diorite, quartz porphyry, hornblende gneiss, and red and gray gneiss. Quartz vein material containing galena, sphalerite, pyrite, and chalcopyrite was found in the dump.

The dumps at the upper adits contain several hundred tons of oxidized ore, consisting mainly of spongy masses of cerussite, smithsonite, manganese oxides, limonite, hematite, and quartz, with small amounts of galena, sphalerite, and pyrite.

Indications are that most of the ore mined above the middle adit was highly oxidized and leached. No ore was mined below the middle adit. None of the mine workings were accessible when visited in 1949.

<u>Eighty Eight ("88") (Ag-Pb-Zn-Cu)</u>

The Eighty Eight group of five patented claims extends to both sides of Carpenter Creek about 1 mile up from its junction with Belt Creek. The "88" and the Fraction claims adjoin the Mountain Chief claim at the north.

Most of the claims were located by the Hudson Mining Co. in the 1880's. Little work has been done since the Hudson Mining Co. ceased operations in 1890. Though some ore is known to have been mined from the "88" claim, no production records are available. The group now is owned by the Combination Gold Mining Co., c/o W. B. Carroll, Great Falls, Mont.

Two southward-trending adits have been driven on the "88" claim. The lower adit is reported to be about 1,700 feet long. As indicated by the dump material, this adit penetrated several varieties of gneiss, porpyry, and diorite. A small amount of material on the dump contains galena, sphalerite, pyrite, cerussite, and iron oxides in quartz and ankerite. According to W. B. Carroll, this adit was driven to develop the Mountain Chief vein at depth but was driven nearly parallel to or at a slight angle with that vein.

The upper adit is about 400 feet higher in altitude and about 1,000 feet south of the lower adit. The dump material at the upper adit is mainly an altered light-colored porphyry. No ore minerals were in evidence.

A Bureau of Mines sample of ore found on the lower adit dump assayed 0.015 ounce gold, 0.2 ounce silver, 17.0 percent lead, 22.3 percent zinc, and 3.4 percent copper.

The adits were inaccessible in 1949.

New Alicia and New Rodwell (Ag-Pb-Zn-Cu)

The New Alicia and New Rodwell claims are about one-fourth mile north of the open pit of the Silver Dyke mine. They are at a high altitude on the north slope of the divide between Squaw Creek and Hoover Creek. The claims were located by a Mr. Combs in 1923 but later were abandoned. Paul Vdovic of Neihart, Mont., purchased the claims from Cascade County in 1941.

The New Alicia claim has been explored by numerous trenches and open cuts and an adit drift about 150 feet long. The vein followed by the adit traverses altered, silicified quartz porphyry. According to Vdovic, the vein is composed mainly of quartz. It averages 2 to 6 inches in width, widening in places to 24 inches. It contains galena, sphalerite, pyrite, chalcopyrite, and their oxidized products. No information is available regarding the development on the New Rodwell claim. No ore has been shipped.

A Bureau of Mines sample taken from a pile of sorted ore on the New Alicia adit dump assayed 1.1 ounces silver, 0.01 ounce gold, 3.6 percent lead, 5.2 percent zinc, and 7.5 percent copper.

The adit was caved at the portal when visited in 1949.

Hatchet (Pb-Zn-Ag)

The Hatchet claim is about 1-1/4 miles up Carpenter Creek and about one-fourth mile east of the "88" claim. It was located in the 1880's and worked intermittently for several years. Since then it has been idle. It is one of three claims now owned by the Silver Horn Mining Co., c/o J. P. Healey, Belt, Mont.

According to Healey, the vein was developed by an adit drift 300 to 350 feet long. The dump material consists of Pinto diorite, gray gneiss, feldspar porphyry, and quartz porphyry. The vein is narrow and irregularly mineralized. Some ore was developed, but it contained too much zinc at the time to warrant shipment to a smelter.

When visited in 1949, the adit was caved at the portal.

Hegener (Ag-Pb-Zn-Cu)

The Hegener group of 10 patented claims is on Mackay Creek about one-half to three-fourths mile above its junction with Carpenter Creek.

The claims were located in the early mining days. They were consolidated later into one group by Joseph Hegener. Most of the development during the early years was done on four of the claims: the Vilipa, originally the Phillippi, Gold Rock, Copper Queen, and Baker. Present owners are John Hegener and Marie Hegener, Great Falls, Mont.

The Vilipa claim was developed in 1897 by a 100-foot adit (29). A 115-foot shaft was sunk on the vein in 1902. A drift at the bottom of the shaft followed the vein southward for 300 feet. The adit was extended to a length of about 400 feet (17). The vein followed the contact along a hanging wall of dark-gray micaceous schist and a footwall of altered porphyry (29). The ore contains galena, sphalerite, pyrite, and silver sulfides. Polybasite was observed in the ore (17). A shipment of 11 tons of ore to the Puget Sound Reduction Co. in August 1901 contained 0.15 ounce gold a ton, 259.8 ounces silver a ton, and 2.7 percent lead. Another shipment of about 12 tons, sent to the same smelter in February 1902, assayed 0.12 ounce gold, 114.1 ounces silver, and 1.0 percent lead. A Bureau of Mines sample selected from ore found on the Vilipa dump assayed 0.06 ounce gold, 111.2 ounces silver, 0.2 percent copper, 0.6 percent lead, and 2.3 percent zinc.

The Gold Rock vein strikes north. It was developed by a 100-foot shaft with a north drift about 50 feet long and a 265-foot adit drift. The vein is reported to be wide and contains a high-grade stringer of sulfides. Sorted ore mined from this stringer averaged 100 ounces silver a ton, 8 percent copper, and 6 to 7 percent lead. The principal ore minerals are galena, chalcopyrite, sphalerite, and tetrahedrite. Native silver, ruby silver, and native copper were present (17). A shipment of 83 sacks of ore sent to the United Smelting & Refining Co. smelter at Great Falls in October 1896 assayed 92.9 ounces silver a ton. No other metals were paid for. Another shipment of about 7-1/2 tons sent to the American Smelting & Refining Co. smelter at Great Falls in July 1899 assayed 44.9 ounces silver a ton. A selected sample of ore from a small vein parallel to and 26 feet distant from the main Gold Rock vein is reported by John Hegener to have assayed 1.10 ounces gold and 710.25 ounces silver. Three small lots of sorted ore from the Gold Rock vein were shipped by lesses to the Washoe Sampler at Butte in October 1922; they assayed 0.1 ounce gold and 94.4 ounces silver, 0.03 ounce gold and 46.8 ounces silver, and 0.04 ounce gold and 61.0 ounces silver.

The Copper Queen vein strikes north. It was developed by two adits - a 165-foot drift adit and a 100-foot crosscut adit. The principal ore minerals are similar to those in the Gold Rock vein (17).

The Baker vein was developed by a 75-foot crosscut adit, which cuts a wide, low-grade, mineralized zone containing some chalcopyrite.

According to John Hegener, the ore produced from the claims had a value of $25,000 to $30,000.

The veins on the claims traverse various gneisses, Pinto diorite, and Snow Creek quartz porphyry, all crossed by a network of dikes mainly of quartz porphyry and granite porphyry. The rock formations in the immediate area are brecciated similar to the brecciation at the Silver Dyke mine (17). In places the brecciated porphyries contain masses and small stringers of sulfide minerals that have been secondarily enriched. One such area on the east side of the Gold Rock claim, near its northern end, has been prospected by many shallow pits, trenches, and short adits. Other brecciated areas containing disseminated sulfide minerals occur along or near the larger veins on the other claims. They have been prospected to shallow depths.

When visited in 1949, all mine openings were inaccessible.

Double X ("XX") (Ag-Pb-Zn)

The Double X claim is on the upper fork of Mackay Creek about three-fourths mile upstream from its junction with Carpenter Creek. It now is included in the Silver Dyke group of claims. H. L. Maury and A. G. Shone of Butte, Mont., are the principal owners.

The claim was located in the early 1880's. Little could be learned of its history or production. The last work was done by lessees about 1934.

According to Schafer (17), the vein follows a well-defined fracture along a porphyry-gneiss contact. According to John Hegener, Great Falls, Mont., it was developed by an adit 300 to 500 feet long and by numerous pits and shallow shafts. Material on the adit dump indicates that the adit penetrated light-colored altered porphyry, gray gneiss, and basic dikes. Pieces of vein quartz found on the dump contain massive galena, light-yellow sphalerite, pyrite, chalcopyrite, and brittle silver sulfides. Weed reports that the rich ores of Upper Mackay Creek were found mainly in rhyolite porphyry; they were the result of secondary enrichment (29).

The Double X adit was closed by a cave a short distance from its portal when visited in 1949.

Dawn and Foster (Pb-Zn)

The Dawn and Foster claims are on the upper west fork of Mackay Creek about 1 mile west of the Silver Dyke mine.

The claims were located in January 1890 and January 1891 by Henry B. Mackay. By 1897 the vein had been developed by several hundred feet of adit drifts (29). Since that time no work has been done. The claims now are owned by Adaline A. Kenkel, Great Falls, Mont.

According to Weed, the ore developed was low-grade and contained much zinc (29). A specimen of nearly pure galena from the claim contained only 0.15 ounce silver a ton. The vein is a well-defined quartz-filled fissure that follows a porphyry-gneiss contact.

The workings were reported to be inaccessible in 1949.

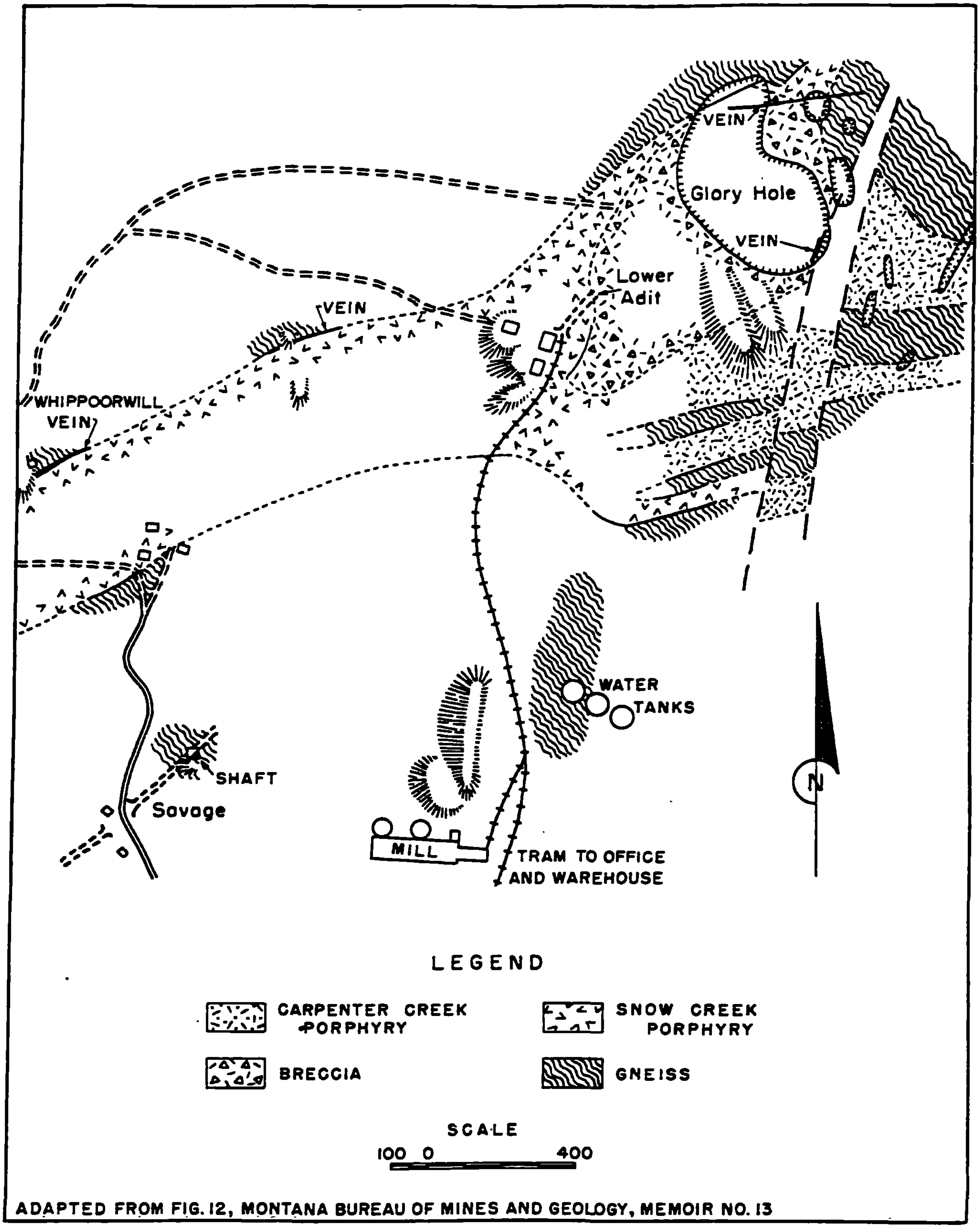


Figure 10. - Sketch showing the geology and surface plant at Silver Dyke mine and vicinity, Montana district, Cascade County, Mont.

Cowboy (Pb-Zn-Ag)

The Cowboy claim is about one-half mile up Lucy Creek from its junction with Carpenter Creek. It is about 2-1/2 miles north of Neihart.

The claim was located in the 1880's, but little could be learned of its early history. According to Sidney Goodman, Armington, Mont., the present owner, two cars of ore were shipped in 1896. After that time, the property was inactive until 1946, when it was leased by Cecil Hoops, et al, Neihart, Mont. Hoops reopened the main adit and attempted to pump out an inclined winze that had been sunk on the vein about 50 feet in from the adit portal. A heavy flow of water was encountered. Another adit about 25 feet lower in altitude then was started to drain the winze. In June 1949 this adit had been advanced about 75 feet.

The vein followed by the main adit is in Pinto diorite. It ranges from 1 to 3 feet in width, strikes N. 62° E., and is nearly vertical. The vein, composed mainly of quartz, calcite, and ankerite, contains bunches and disseminations of galena, sphalerite, and pyrite, with small amounts of silver sulfides. According to Hoops, the winze was sunk on an ore shoot about 75 feet long, which raked steeply to the southwest.

No ore has been shipped since work began in 1946. About 25 tons of sorted ore is stored on the dumps and in an ore bin near the main adit. A Bureau of Mines sample of this ore assayed 4.7 percent lead, 9.8 percent zinc, 0.4 ounce silver, 0.3 percent copper, a trace gold, and less than 0.01 percent tungsten.

When visited in 1949, both adits were open and in good condition. The winze was filled with water to the adit level.

Silver Dyke (Ag-Pb-Cu)

The Silver Dyke mine (fig. 10) is near the top of a high ridge lying northwest of the forks of Carpenter Creek; it is about 3-1/2 miles up Carpenter Creek from its junction with Belt Creek. The deposit was discovered during the early days of mining but was not developed until 1921. During 1922 and 1923, a 500-ton concentrating mill was constructed by Stearns and Rogers. Control of the property then was acquired by the American Zinc, Lead, and Smelting Co. This company began operating in February 1923. In 1926 the mill capacity was increased to 950 tons. Operations continued until April 1929, when the blocked out ore was depleted. A small production was made later by leasers. The property now is owned by H. L. Maury and A. G. Shone, Butte, Mont.

Total production from the Silver Dyke mine as to tonnage mined and quantity of silver, lead, and copper recovered was considerably larger than that of any other mine in the Neihart area. The tonnage mined was obtained from a comparatively small area in which the minerals occurred as disseminations in a brecciated mass of quartz porphyry, granite porphyry, and gneiss. The eliptical deposit was approximately 600 feet long and 400 feet wide. It was mined to a depth of about 150 feet.

The deposit was mined first by open-cut methods (fig. 10). The ore mined in the open-pit or glory hole was delivered through chutes to an adit below, from whence it was trammed to the mill. Later, a lower adit about 1,000 feet long was driven at an altitude of 6,870 feet. Four or more paralleling drifts were driven from this lower adit at 80-foot centers. Two sets of vertical raises 100 feet apart were driven to connect with the workings above. All ore from the open-pit and intervening underground workings then was delivered to the new lower adit, which became the main haulage level (30). Ore from the open-pit was withdrawn through chutes as rapidly as possible to prevent packing of the sticky material. During winter months, or when wet weather interfered with open-pit operation, mining was done underground. Because of the shape, size, character, and attitude of the deposit, extensive underground workings were not required.

During an 8-month period, 1926-1927, when about 700 tons of ore was being milled daily, the cost of mining, including overhead and management charges, was only 42¢ per ton (30). At that time mill heads contained 0.78 percent copper, 1.56 percent lead, and 4.48 ounces silver a ton, of which about 16 percent of the lead and 25 percent of the copper were oxidized. Tailings average 0.22 percent copper, 0.44 percent lead, and 0.91 ounce silver a ton. About 23 percent of the lead and 46 percent of the copper in the tailings were in the oxidized forms. Recoveries were excellent, considering the physical character of the ore and its chemical composition; they averaged 72.94 percent of the copper, 73.09 percent of the lead, and 80.55 percent of the silver. The ratio of concentration was 13.15. A lead concentrate and a copper concentrate were produced by flotation. The lead concentrate was shipped to the East Helena smelter; the copper concentrate went to the copper smelter at Anaconda. Cost of hauling the concentrates by truck to the loading platform at the railroad, 3-1/2 miles distant, was $1.50 a ton (30). Production from 1921 to 1948, inclusive, is reported to have been 1,167,125 tons of ore, from which 1,736.67 ounces gold, 3,177,068 ounces silver, 7,453,527 pounds copper, 16,367,760 pounds lead, and 8,428 pounds zinc were recovered (14).

The ore was a complex mixture of both sulfide and oxide or carbonate minerals disseminated in a gangue of highly altered quartz porphyry and gneiss. Minerals present were galena, cerussite, pyrite, chalcopyrite, malachite, azurite, iron oxides, and small amounts of sphalerite. The silver minerals were not identified. The ore contained about 20 percent colloidal material, principally kaolin (17).

The origin of the ore has not been definitely determined. It is possible that brecciation occurred when the Carpenter Creek porphyry was injected into the more brittle Snow Creek porphyry. Solutions containing the ore minerals penetrated the breccia and were deposited irregularly. The nearby Whippoorwill and Savage veins may have been the feeder channels through which the mineral-bearing solutions circulated.

In 1949 the adits were inaccessible; the big open-cut had sloughed from the sides and contained much debris. Access raises from the underground workings were caved.

Savage (Pb-Zn-Ag)

The Savage mine is on the east side of Squaw Creek about one-fourth mile from its junction with Carpenter Creek. The claim was located in 1885 by the Savage Lode Mining Co. For many years it has been included in the Silver Dyke group of claims. It now is owned by H. L. Maury (2/5) and A. G. Shone (3/5), both of Butte, Mont. The mine was operated by Buskirk, Berland Bros., and Paul Vdovic in 1948 and 1949. The ore mined and some coarse tailings from the old Silver Dyke mill were treated in a small selective flotation plant erected by these lessees at the site of the old Silver Dyke flotation plant.

In the earlier days, the mine was worked through a 100-foot shaft sunk on the vein. Ore was stoped to about 50 feet above a drift driven north from the bottom of the shaft. The present lessees drove an adit drift on the vein from near Squaw Creek to the shaft and beyond for a length of 400 to 500 feet (fig. 10). Some ore was found just south of the shaft and was stoped for a short distance above the adit level. This work terminated during the summer of 1949. No production data are available.

The vein traverses an altered gray gneiss. It strikes N. 40° to 45° E. and dips 75° to 80° NW. Where exposed in the stope south of the shaft, the vein is 3 to 5 feet wide. It is composed mainly of altered banded gneiss containing some disseminated sulfides, with two narrow bands of sulfide minerals near the walls. The principal sulfide minerals are galena, sphalerite, and pyrite, which usually occur in fairly large crystalline form. Some of the sphalerite and pyrite are coated with films of silver sulfides.

A Bureau of Mines sample of ore found in the mill ore bin assayed 0.025 ounce gold, 29.8 ounces silver, 3.1 percent lead, 3.6 percent zinc, and 0.1 percent copper.

Power for the small mill was obtained from the Montana Power Co. line leading to the nearby Silver Dyke mine. Both lead and zinc concentrates were produced. The lead concentrate was trucked to East Helena. The zinc concentrate was shipped to Great Falls.

When visited in 1949, the adit was in good condition and accessible to its face, about 75 feet north of the old shaft.

Whippoorwill (Blotter) (Ag-Pb)

The Whippoorwill claim, patented as the Blotter, adjoins the Double X claim at the northeast. It is on the ridge between the headwaters of Mackay Creek and Squaw Creek, about one-half mile southwest of the Silver Dyke mine.

The claim was located in the early 1880's. It has been worked intermittently since 1884 by the Whippoorwill Mining Co., the Silver Dyke Mining Co., and by various lessees (10). The last work was done about 1922 or 1923 by the Carpenter Creek Mining Co. The present owners are H. L. Maury and A. G. Shone of Butte, Mont.

The Wippoorwill vein occurs along a contact of Snow Creek quartz porphyry with gneiss. It was developed by a shaft reported to be 250 feet deep, with crosscuts and drifts on several levels (1). A 40-foot winze was sunk, and some drifting was done by the Silver Dyke Mining Co. in 1922. Ten tons of lead ore is reported to have been shipped during the same year by the Carpenter Creek Mining Co. (22-1922).

The ore is reported to contain galena, sphalerite, and notable amounts of chalcopyrite. The silver content is low, except near the surface, where it is secondarily enriched (17).

The mine workings were inaccessible in 1949.

Sherman (Flamsburg) (Ag-Pb-Zn)

The Sherman claim, Survey No. 10,442, was known for many years as the Flamsburg. It is on Carpenter Creek about 3-1/2 miles up Carpenter Creek from Belt Creek and about 150 yards southeast of the Savage mill.

The claim was located in the 1880's and was operated intermittently on a small scale for several years. Lessees operated the property about 1933 or 1934 and produced some ore from a shallow adit and surface pits. In recent years the lower adit was reopened by Berland Bros., Buskirk, and Vdovic. A small mill was constructed. Some ore and dump material were milled. A bulk lead-zinc-silver concentrate was produced on one large concentrating table. Some dump material was treated later at the Savage mill. The property is owned by H. L. Maury (7/10) and A. G. Shone (3/10), both of Butte, Mont. No production data are available.

According to Paul Vdovic, the vein has been developed at an adit drift about 400 feet long, by an adit crosscut about 50 feet long, and by a shaft about 35 feet deep. The adit drift follows a fissure vein in Snow Creek porphyry and gray gneiss. The vein, from 2 inches to 24 inches wide, strikes N. 15° to 41° W. It dips 75° to 80°NE. According to Wm. Mehaney, Neihart, Mont. the ore in this adit occurred in short lenses ranging in width from 1 to 12 inches. The vein walls were kaolinized and soft.

Sorted ore mined from the shaft and a small underhand stope is reported by Vdovic to have contained as much as 46 percent lead and 36 to 40 ounces of silver a ton. Galena, sphalerite, pyrite, chalcopyrite, and silver sulfides are the principal sulfide minerals. Some cerussite also is present. Schafer (17) reports the presence of pyromorphite occurring as thin needles associated with the galena. The gangue minerals are calcite, limonite, ankerite, and quartz. A Bureau of Mines sample of ore found on the dump at the lower adit assayed 1.4 ounces silver, 22.2 percent lead, 21.1 percent zinc, 1.1 percent copper, and a trace gold.

When visited in 1949, the lower adit was blocked by a cave near the portal; the shaft had caved.

Minute Man (Last Hope-Westgard) (Ag-Pb-Zn)

The Minute Man, known also as the Last Hope and as the Westgard claim, is on the side hill south of Carpenter Creek about one-fourth mile south from the Savage mill. It is about 3-1/2 miles northeast of Neihart.

According to Wm. Mehaney, Neihart, Mont., the claim was located about 1924 by Thomas Westgard. It was worked intermittently by him for several years. After Westgard's death, his interests were acquired by Dan Reeder and George Spehn of Great Falls, Mont. No developing has been done in recent years, although a new road was bulldozed to the main adit in 1948.

Production from 1932 to 1944, inclusive, is reported to have been 317 tons of ore, from which 5.45 ounces gold, 3,278 ounces silver, 2,839 pounds copper, 33,912 pounds lead, and 31,771 pounds zinc were recovered (14).

Development consists of several adits and a 48-foot shaft with a short drift. One of the lower adits is reported to be about 300 feet long (17). The main adit, according to Mehaney, is about 700 feet long. It follows a vein that occupies a strong fracture in gneiss. The vein ranges from 2 to 7 feet in width. Several ore shoots were encountered. Sorting of the ore to a high-grade shipping product, however, was difficult because of the softness of the vein material and the walls. The vein exposed near the portal of the upper adit is composed of three bands of quartz 12 to 24 inches wide separated by 6-inch bands of silicified gneiss. It strikes about N. 60°W. and dips 80° NE. The dump at this adit contains vein material consisting mainly of honeycombed, iron-stained quartz with cerussite, limonite, hematite, and possibly smithsonite.

Vein material found on the dump at the lower adit consists of altered gneiss and quartz containing galena, sphalertie, pyrite, chalcopyrite, and small amounts of silver sulfides. A Bureau of Mines sample selected from this material assayed 0.5 ounce silver, 16.3 percent lead, 1.5 percent zinc, 1.3 percent copper, and a trace gold.

Caved stopes along the strike of the vein followed by the main adit indicate its strike to be about N. 60° W., the same as the strike of the vein showing at the upper adit. The workings, however, appear to be on different but parallel veins.

When visited in 1949, the adits and the shaft were inaccessible owing to caving.

Big Ben Molybdenum (Mo)

The Big Ben group of eight claims and a millsite is on the north slope of the ridge between Snow Creek and upper Carpenter Creek, about 2-1/2 miles northeast of Neihart.

Three of the claims were located by Frank Mansikka of Neihart, Mont., in 1922. He located the other claims and the millsite between 1926 and 1940. All of the claims still are held by Mansikka..

The Big Ben property is reported to have been examined by the Climax Molybdenum Co., Anaconda Copper Mining Co., and the U. S. Vanadium Corp. In 1938 the Federal Mining & Smelting Co. obtained an option and did considerable surface trenching, sampling, and geologic mapping. At the request of the War

Production Board, the property was examined by the Bureau of Mines in 1942 as a possible strategic source of molybdenum.

In 1943 the Bureau of Mines began and completed a program of diamond core drilling, channel-sampling of the underground workings, surveying, and metallurgical testing. Four diamond core-drill holes were drilled for a combined length of 1,365 feet. The entire length of the Big Ben lower adit was channel-sampled in 5-foot sections. Although the full extent of the mineralized zone was not determined, core-drill holes and adits penetrate a prism 520 feet long, 270 feet wide, and 365 feet deep. Weighted averages of the drill core samples ranged from 0.19 to 0.26 percent MoS_2. Channel samples for a continuous length of 295 feet in the lower adit ranged from 0.01 to 0.32 percent MoS_2 and averaged 0.21 percent. Metallurgical testing indicated that concentrates containing 84 to 88.9 percent MoS_2 can be produced by standard flotation (8).

Development consists mainly of an upper 290-foot adit and a 340-foot lower adit in the Great Ben No. 2 and No. 3 claims. The upper adit is at an altitude of 6,006 feet, 78 feet higher than the lower adit. The face of the lower adit is almost directly under the portal of the upper adit. Short drifts and crosscuts have been driven on the more highly mineralized fissures exposed in the adits. Numerous surface trenches and pits have been dug; one series of trenches with a combined length of about 500 feet was excavated in 1938 by the Federal Mining & Smelting Co.

Mansikka has extended the lower adit about 40 feet since the Bureau of Mines completed its investigation and has drifted to the east along a fracture following the contact of Carpenter Creek granite porphyry and Snow Creek quartz porphyry.

When visited in 1949, both adits were in good condition and accessible to their faces.

The deposit appears to be a stockwork in which molybdenite and other associated sulfide minerals occur in irregular fractures and as disseminations in silicified zones in pre-Beltian gneisses, porphyries, and Pinto diorite. The principal rock in the Big Ben area is a rhyolite porphyry, locally known as Snow Creek quartz porphyry. It occurs as masses and as dikes that cut older gneisses, schists, and diorite. A later intrusive rock, the Carpenter Creek granite porphyry, intrudes the Snow Creek quartz porphyry. Both formations have been fractured and altered. Most of the fractures are quartz-filled; many of them contain molybdenite. The degree of mineralization differs in the different rocks. Samples from the gneiss indicate the mineral content to be lower than that of either the Snow Creek quartz porphyry or the Pinto diorite. The Carpenter Creek granite porphyry is only slightly mineralized. Much of the mineralized area is covered with overburden ranging from 3 to 15 feet in thickness.

Molybdenite, the principal valuable mineral, is associated with pyrite and minor amounts of galena, chalcopyrite, and fluorite; it is replaced partly by molybdite (hydrous ferric molybdate) to a depth of 15 to 20 feet below the overburden. The molybdenite and galena are associated intimately. The presence of tungsten was noted, but samples indicate the average WO_3 content to be less than 0.01 percent.

The occurrence of moybdenite on Snow Creek about 2,500 feet south of the Big Ben deposit, and in the vicinity of Mackay Creek about half a mile and more to the north of the Big Ben is reported by Schafer (17).

Frisco (Ag-Pb-Zn)

The Frisco claim is near the northern limits of the town of Neihart. The claim was located originally in June 1882 but was abandoned later. It was relocated October 10, 1886, by Charles Crawford, et al, and subdivided into town lots, some of which extend across Belt Creek. In 1939, some of these lots on the west side of Belt Creek were purchased from Charles Fors by Spehn and Klies for use as a tunnel site. An adit was driven N. 80° W. from that site for about 625 feet to prospect for a vein considered to be the southern extension of the Equator vein. Two veins were intersected. The first was crossed at about 445 feet, the other near the face. The first vein was drifted south for about 20 feet, where a raise was driven on a short ore shoot. The vein at the face of the adit was drifted on for about 10 feet. The first vein contained some ore but was considered too narrow to warrant further development. Both veins are narrow, quartz-filled fissures in hard, gray gneiss. The first vein, where the raise was driven, contained galena, honey-yellow sphalerite, and pyrite with coatings and films of brittle silver sulfides. No ore was shipped.

A Bureau of Mines sample selected from ore found on the dump assayed 51.6 ounces silver, 0.07 ounce gold, 33.3 percent lead, and 9.5 percent zinc.

When visited in 1949, the adit was open and in good condition to the face. The raise had caved.

Graham and Hollowbush (S & R)(Ag-Pb-Cu)

The Graham and Hollowbush, or S & R, mine is on the west side of Belt Creek near its junction with O'Brien Creek at the southern end of the town of Neihart. Present ownership was not learned.

The vein, believed by some people to be the southward extension of the Broadwater vein, first was developed by an adit driven on the vein from its outcrop near the water level of Belt Creek. According to Carl Faller, Neihart, Mont., some rich silver ore was mined from this adit. No further work was done on the claim until 1934. The property then was leased by George Spehn and Dan Reeder. A 250-foot shaft was sunk in the footwall of the vein, and crosscuts on the 100- and 250-foot levels were driven to the vein. Drifts were driven north and south on both levels. One short ore shoot was mined between the 250-foot shaft level and the adit level. Operations ceased in 1943, when additional pumping equipment was needed to handle the large flow of water encountered on the 250-foot level.

Much of the ore mined was too low grade to permit shipment direct to the smelter; it accumulated on the dumps. This material was milled in 1942 and 1943 in the Klies Milling Co. mill, later known as the Neihart Mine & Milling Co. mill (22-1942).

Production records for the early operations are not available. Production from 1934 to 1943, inclusive, is reported to have been 5,636 tons of ore, from which 6.25 ounces gold, 28,038 ounces silver, 3,506 pounds copper, and 186,445 pounds lead were recovered (14).

According to Joe Boucher, Havre, Mont., the vein was about 2 feet wide on the adit level; on the 100- and 250-foot levels it was 4 to 6 feet wide. It strikes north and dips about 80° to 85° W. The vein is composed mainly of quartz or silicified, altered, gray gneiss. The ore minerals occurred mainly in an irregular band at about the center of the vein. Silver sulfides, pyrite, chalcopyrite, galena, and sphalerite also are isseminated through the vein material. A Bureau of Mines sample of material of this type found on the dump assayed 2.5 percent lead, 2.5 percent zinc, 4.3 ounces silver, 0.1 percent copper, and a trace of gold.

According to Boucher, the vein splits a short distance north of the crosscut on the 250-foot level. The main ore shoot rakes to the south. No ore has been mined below the 250-foot level.

When visited in 1949, the adit was inaccessible owing to caving and accumulated water. The shaft and headframe apparently were in good condition; the shaft was filled with water to about 75 feet below the collar.

Ruth Mary and Fitzpatrick (Ag-Pb-Cu)

The Ruth Mary and Fitzpatrick claims are on the west side of Belt Creek about one-quarter mile south of the town of Neihart.

The Fitzpatrick claim was located in 1883 by John Largent. It was surveyed for patent in October 1883. In 1910 it was owned by Robert Ford (25). It now is owned by Lee M. and Elizabeth W. Ford, Sun River, Mont. The two veins on this claim were developed by adit drifts. The main vein was developed by two adits, the upper one being short. The main, or Firzpatrick, adit, about 30 feet below the upper adit, was driven about 750 feet to the north end line of the Ruth Mary claim. Ore was stoped a short distance in from the portal of the Fiszpatrick adit up to the upper adit level. Farther south, a number of raises ranging from 45 to 120 feet in length were driven in other short ore shoots. The second vein, about 100 feet west of the main vein, was drifted on for about 100 feet.

The Ruth Mary claim, unsurveyed, adjoins the Fitzpatrick claim at the south. Though also located in the 1880's, little development was done until long after operations on the Fitzpatrick claim had terminated. Arrangements were made by Tony Faller, then the owner of the Ruth Mary claim, for the use of the Fitzpatrick adit. Faller then advanced this adit another 550 feet and for several years thereafter mined the Ruth Mary at intervals. A royalty of

25 cents a ton on all ore shipped was paid the owners of the Fitzpatric claim. The Ruth Mary claim was later leased to McCaffrey and Williams, who mined a small amount of ore (22-1922). Some work was done about 1934 by Tom and Charles Huxley. Other lessees produced a small amount of ore in 1937. Since then the mine has been idle. Present owners are Earl and Carl Faller, Neihart, Mont.

One ore shoot nearly 100 feet long on the Ruth Mary claim was mined for a short distance above the adit level. According to Sam Williams, Belt, Mont., this ore shoot occurred about 1,100 to 1,200 feet in from the adit portal. A 65-foot winze was sunk on the vein at the 1,150-foot point, where the vein averaged 3 feet in width. A heavy flow of water prevented further sinking. Several other ore shoots were developed and mined. The ore shoots in the Ruth Mary claim were about equally spaced along the adit, usually at deflections on the hanging-wall or west side of the vein; it widened at these points to 2 or 3 feet and contained a rich band or stringer 6 to 8 inches in width. The vein is reported to be cut off by a fault at the face of the adit.

The Ruth Mary-Fitzpatrick vein occurs in gray gneiss. It strikes N. 3° E. and dips 85° NW. The vein walls are altered slightly to sericite and kaolin (17). The minerals are mainly silver sulfides with galena, sphalerite, pyrite, and a small amount of chalcopyrite. Cerussite was abundant in much of the ore mined. The presence of this mineral along with small amounts of malachite, azurite, and coatings of supergene ruby silver indicates secondary enrichment (17). A Bureau of Mines sample of some ore found in an old ore bin assayed 0.005 ounce gold, 21.3 ounces silver, 1.4 percent lead, 0.2 percent copper, 0.1 percent zinc, and less than 0.1 percent atimony.

According to Carl Faller, 12 tons of ore shipped in 1934 averaged 268 ounces silver a ton. Earlier production records are not available. Production from 1934 to 1937, inclusive, is reported to have been 50 tons of ore, from which 5,096 ounces silver, 1,630 pounds lead, and 251 pounds copper were recovered (14).

When visited in 1949, the main adit was accessible for about 100 feet, where it was blocked by the caving of an old stope. The adit drift on the west vein was open and in good condition.

<u>LeRoy (Johannesburg)(Au)</u>

The LeRoy claim, one of a group of seven patented claims and a millsite, is about 4 miles northwest of Neihart. This area is considered a part of the Montana (Neihart) district, although it also has been known as the Johannesburg district.

The LeRoy mine is about half a mile up Johannesburg Creek, a west tributary of Belt Creek. The claims were located sometime prior to 1905. At that time, they were owned by Nelson and Meetzger, who drove a 100-foot adit with several crosscuts. These crosscuts indicated a mineralized zone about 20 feet wide (23). The claims were abandoned later but were relocated April 13, 1907, by the Johannesburg Gold Mining Co. This company sank a 500-foot shaft with drifts on several levels. Considerable work was done on the 300-foot level, where extensive bodies of low-grade ore were reported (25). Later, the claims again were abandoned. They were purchased eventually for taxes from Cascade County by Paul Vdovic, Neihart, Mont., who is the present owner.

According to Vdovic, the best ore was cut by a crosscut on the 200-foot level. The ore occurs in silicified altered zones in a hornblende gneiss, mainly in small quartz-filled fractures containing iron sulfides, iron oxides, and a little chalcopyrite. The ore is reported to have averaged about 0.20 ounce gold a ton, although picked samples assayed \$106 to \$550 in gold.

A Bureau of Mines sample of some of the best appearing ore found on the dump at the shaft assayed 0.14 ounce gold, 0.05 ounce silver, 0.05 percent copper, 0.05 percent nickel, and 21.0 percent iron a ton. About 800 tons of oxidized ore is on the mine dump. No ore has been shipped or milled.

When visited in 1949, one of the adits south from the shaft was open and in good condition. The shaft was filled with water to within 20 feet of the collar. Pits and open-cuts on the claims north from the shaft had sloughed.

Other Mining Claims

Other located and patented mining claims in the Montana (Neihart) district have been mentioned briefly in reports and publications. A number of these claims are reported to have been productive of some ore; virtually all of the old workings now are inaccessible. Several of the following claims are included in groups or mines heretofore described.

The Concentrated and Monarch claims (Ag-Pb) are part of the Florence group now owned by the Bennett Mining Co. They adjoin the Florence and British Lion claims on the west. According to Weed (29, a 1,500-foot adit was driven at a slight angle toward the Florence on a vein that averaged 3-1/2 feet in width. A crosscut near the face of the adit intersected another vein. The Inspector of Mines for Montana reported in 1891 and 1892 that the vein was developed by a 1,500-foot adit, and a 2-compartment winze that was being sunk at a point 250 feet in from the adit portal. In 1891 the winze was 60 feet deep. Operations were discontinued in 1892 because of a heavy flow of water encountered in the winze. One 7-ton shipment of ore yielded 108 ounces silver and \$5 gold a ton (9)(10).

The Nevada claim (Ag-Pb), Survey No. 2680, adjoins the Galt claim at the north. It was located in October 1886 by William Kane, et al. It now is owned by Neihart Realty Co., c/o J. P. Healy, Belt, Mont. (29/30), and L. B. Stark, Neihart, Mont. (1/30). According to Stark, the vein on the Nevada claim is a continuation of the Galt vein. It has been developed by a 250-foot shaft with several levels. Some good silver ore is reported to have been mined by early owners.

The Hidden Treasure claim (Ag-Pb) lies west of the Broadwater claim; it adjoins the Atlantus and Maggie claims of the Hartley group at the south. An adit several hundred feet long was driven on the Hidden Treasure vein by early operators. No work has been done for many years. It is owned by Mrs. J. E. Sites and Neta Chamberlain of Helena, Mont.

Several groups of claims were located many years ago on both sides of Harley Creek near its junction with Belt Creek. This locality is about 2 miles northwest of Neihart. According to Weed (29), the Imperial group of eight claims had a 450 foot adit, the Royal group had a 200-foot adit, and the Granite Mountain group had a 225-foot adit. Ore samples from the Granite Mountain group are reported to have assayed as high as 12 to 20 percent copper and several dollars in gold. No work has been done on any of the claims for many years. All workings are inaccessible.

The Blizzard (Ag-Pb) is a fractional claim between the Pennsylvania claim of the Lexington group and the Spotted claim. It is on the top of the ridge between Snow Creek and Belt Creek. Little could be learned of its early history. According to D. L. Ledbetter, Great Falls, Mont., a shaft 40 to 50 feet deep was sunk on the vein; some rich silver ore was mined. The claim is owned by Edith Ledbetter, Great Falls, Mont.

The Bull of the Woods claim (Au-Ag) is near the top of the west slope of the Neihart Baldy Mountain about half a mile east of Neihart. The claim was located April 1, 1890, by Herbert L. Robinson, et al. Later it was owned by Dorcus B. Cottier of Great Falls, Mont., who sold it to D. Reeder and Claus Erlandson. Erlandson's three-fourths interest was purchased later by P. Vdovic of Neihart, Mont. Neihart quartzite is the only rock formation exposed. A quartz-filled fissure vein occurs in the quartzite. According to Vdovic, early miners are reported to have mined a small amount of high-grade silver ore from this vein.

Barker District

The Barker district includes the area in the vicity of Barker, Hughesville, and the headwaters of the Dry Fork of Belt Creek. It is approximately 10 miles northeast of Neihart and about 9 miles east of Monarch (fig. 1). All of the Barker district at one time was within Cascade County. With the formation of Judith Basin County in 1920, most of the mines and mineral deposits in the district came under its jurisdiction. The common boundary line between the two counties now cuts through the western part of the district, leaving a few mines and mining claims in Cascade County. The underground workings of several mines now in Judith Basin County extend into Cascade County. The mines and mineral deposits in Judith Basin County will be described in a separate report on that county. Only those mines on the Cascade County side of the district will be described here. On the Cascade County side, two properties have been worked rather extensively but intermittently; several others have been worked on a small scale by lessees. Little systematic development has resulted.

Fairplay and Bon Ton (Pb-Zn-Ag)

The Fairplay and Bon Ton claims are on the east side of Barker Mountain about three-fourths mile west of Hughesville. The claims were located in the 1880's. They were operated intermittently by their owners and lessees until about 1892. Not much was done, however, until 1942, when the claims were leased by the Thorson brothers of Monarch, Mont. From 1944 to 1946 they were operated by Andrew Fineide and Ray Cecil of Monarch, Mont. Since then the properties have been idle. The Fairplay claim is owned by Mrs. Minnie Browning, et al, of Belt, Mont. Cascade County records show the city and county of Denver, Colo., to be the owner of the Bon Ton claim.

The ore occurs in replacements along the contact of thin-bedded Madison limestone and granite porphyry (29). The deposits average about 3 feet in width. The contact strikes N. 3° W. and dips 70° NE.

The Fairply claim has been opened by an 800-foot adit, which follows the contact for about 300 feet. An ore shoot about 60 feet long was developed at a depth of about 140 feet below the surface. According to George N. Bennett, the ore in this shoot had been mined above the adit level before February 1945. At that time, a winze being sunk from the adit level had reached a depth of 50 feet. The extent of the development on the Bon Ton claim could not be learned.

The ore minerals are mainly galena and sphalerite with pyrite and a small amount of chalcopyrite. Calcite and quartz are the principal gangue minerals.

Production records prior to 1942 are not available. The sorted ore produced between 1942 and 1946 was shipped to the U. S. Smelting, Refining, & Mining Co. smelter at Midvale, Utah. This production is reported to have amounted to 1,956 tons, from which were recovered 7.00 ounces gold, 8,793 ounces silver, 1,863 pounds copper, 289,600 pounds lead, and 749,400 pounds zinc (14).

The adit on the Fairplay claim was accessible in September 1949.

Silver-Bell (Ag-Pb-Zn)

The Silver, Southern Bell, and Bell claims are a short distance west and north of the townsite of Barker, formerly known as Clendennin. The Silver and Southern Bell claims are in Cascade County. Most of the Bell claim is in Judith Basin County. According to MacKnight (13), the Silver and Bell claims were located October 13, 1880, by H. C. Foster.

The claims were operated quite extensively for several years. During 1883, 2,500 tons of ore was produced and smelted in the Clendennin smelter. This ore is reported to have been mined from the upper workings in the Silver claim; it averaged 21 ounces in silver and 50 percent lead. About 420 tons of ore was mined from the lower workings, but this ore was not shipped until after the railroad was built to Barker in 1891. Some of this ore is reported to have contained 200 ounces silver a ton. From 1884 to 1890 the mine was closed (11). In 1892 the mine was operated by J. T. Armington, E. D. Barker, & Co. (9). According to MacKnight (13), the production in 1892 from the lower workings amounted to more than 20 carloads of ore; 8 carloads were produced from the upper workings.

After Armington, Barker, & Co. stopped operations, nothing further was done until 1928 or 1929, when the mine was leased by Paul Vdovic, et al. According to Vdovic, 58 tons of ore was shipped during 1929; this ore averaged 42 ounces in silver a ton and 42 percent lead. The property has been idle since 1929. The Silver and Southern Bell claims are owned by Mrs. Minerva L. Davis, Great Falls, Mont. The Bell claim is owned by the Armada Co., c/o George Huston, Great Falls, Mont.

Development on the Silver claim consists of several upper adits and open cuts and a lower adit driven westward from near the Dry Fork of Belt Creek. An 80-foot shaft was sunk the portal of the lower adit in 1892. On the 80-foot shaft level, a crosscut was driven north about 60 feet, where a vein 6 feet wide containing banded lead and zinc sulfides was intersected. When the mine was leased in 1928-29, a drift was driven westward along this vein for about 40 feet. A crosscut was driven southward through a hard, black, brecciated rock for about 50 feet. This rock contained scattered crystals of lead and zinc sulfides. A heavy flow of water from the northwest corner of the shaft prevented further exploration.

According to Weed, the ore occurs at the contact between the limy shale of the Barker formation and an intrusive sheet of porphyry (27). According to MacKnight, the ore mined from the upper workings contained mainly lead carbonate interbedded with the limestone (13). Sorted material found on the shaft dump contains lead and zinc sulfides. A Bureau of Mines sample of this material assayed 0.005 ounce gold, 3.2 ounces silver, 5.8 percent lead, 8.0 percent zinc, 0.05 percent copper, less than 0.10 percent cadmium, and less than 0.01 percent nickel.

When visisted in 1949, all of the upper adits and the open-cuts were caved and inaccessible. The lower adit was accessible for a short distance but was in very poor condition. The shaft was full of water to within about 20 feet of the collar.

Carbonate (Logging Creek) District

The Carbonate district (unorganized), also known as the Logging Creek district, is near the head of Logging Creek, about 14 miles northwest of Neihart. It covers an area of approximately 10 square miles. Most of the mining claims are arranged in contiguous groups on the north slope of the Little Belt Mountains, about 1 mile northwest of Mount Pilgrim; several of these claims extend across the divide into Meagher County. A few claims lie to the north, east, and south at distances of one-half to several miles from the main groups.

Most of the claims are at altitudes greater than 7,000 feet. The district of one-half to several miles from the main groups.

Most of the claims are at altitudes greater than 7,000 feet. The district is accessible by Forest Service roads and trails during the summer and early fall. Deep snow covers the area during the long winters. Although the roads and trails are used infrequently, they are passable to trucks and some automobiles during dry weather. The mountain slopes near the crest of the divide are rounded. Erosion has cut deep, steep-walled canyons on both sides of the divide. The north slopes generally are heavily forested with spruce, fir, and lodgepole pine. Only a small short-seasonal supply of water is available for mining and milling at the properties, but at lower altitudes some springs provide a year-round flow.

Many claims were located and patented during the 1880's or 1890's. Numerous other claims were located but later abandoned. No deep or extensive developing has been done. Most of the old shaft, adits, and open cuts are caved or otherwise inaccessible.

The ore deposits occur in the metamorphosed zones of sedimentary rocks at or near contact with igneous rocks or in fractures in limestone some distance from the intrusive rocks. Virtually all of these deposits are small and, because of their isolated location, have not been profitable to mine.

Nilson (Ag-Pb-Au)

The Nilson group of 21 patented claims is in secs. 31, 32, and 33, T. 15 N., R. 6 E., and secs. 5 and 6, T. 14 N., R. 6 E. The claims are owned by G. W. Nilson, Great Falls, Mont. Some of the claims were purchased from Cascade County at tax sale in 1940 or 1941. The rest were purchased from C. W. Hay, the original owner.

According to Nilson, two short adits have been driven along the contact of an igneous rock and limestone. Both of these adits were reported to be inaccessible. No ore has been shipped from any of the claims.

Gavander (Ag-Pb-Au)

The Gavander property, consisting of three patented claims - the Admiral Dewey, the Overlooked, and the Gold Bug - is west of the Nilson group. It is owned by J. A. Gavander, Great Falls, Mont. The contact of a quartz porphyry with thin-bedded, steeply dipping, shaly limestone has been prospected by many shallow pits and short adits. Dumps at several of the old pits indicate they were sunk mainly in an altered iron-stained porphyry. A small amount of cerussite and galena was found on one of the dumps. No work has been done for several years. No production records are available. According to Mrs. J. A. Gavander, a small amount of ore was shipped from one of the claims many years ago. When visited in 1949, the pits and open cuts had sloughed and the adits were closed by caving.

Copes (Ag-Pb-Zn)

The Copes property, consisting of four unpatented claims - the Ajax No. 1 and No. 2 and the Leadville No. 1 and No. 2 - is about 1 mile southeast from the Nilson group. Two of the southernmost claims are in Meagher County. The claims were located in the 1880's by Copes, Sr., and were worked intermittently for many years. In recent years they were worked on a small scale by the Copes brothers. V. E. Copes of Neihart, Mont., is the present owner.

Development consists of numerous shallow shafts, open cuts, and short adits. The principal workings are on a narrow ridge extending south from the divide, where a quartz vein crosses flat-lying beds of thick-bedded blue limestone. This vein strikes N. 56 W.; its dip is vertical. As exposed along the outcrop, it is lens-shaped, about 24 inches in maximum width, and within a length of about 20 feet tapers at both ends to a knife edge. A 20-foot shaft was sunk a short distance southeast of the outcropping lens but encountered only a few narrow flat-lying seams of quartz and calcite. An adit was driven southeasterly from the northwest side of the ridge about 75 feet below this outcrop. Dump material at this adit contains a small amount of galena and cerussite. V. E. Copes reports 4 tons of high-grade lead ore was shipped from the open-cut in the outcrop. A Bureau of Mines sample selected from ore specimens found on the dump at the open-cut assayed 0.005 ounce gold, 3.6 ounces silver, 19.8 percent lead, and 6.9 percent zinc.

When visited in 1949, the shaft, cribbed with 10-inch round timbers, was in good condition. The open cut in the outcrop was partly filled with debris. The adit was caved.

Other Mining Claims

Numerous other mining claims were located in the district years ago. Many of these claims were patented. The little information available regarding these claims is given in the following:

The Excelsior and Gone By claims (Ag-Pb) are south of the Gavander group. Some of these claims extend across the divide into Meagher County. Steve Pozdar, Great Falls, Mont., is the owner.

The Parnell and Board of Trade claims (Ag-Pb) adjoin the Excelsior and Gone By claims on the east. Most of these claims are in Meagher County. They are owned by Michael F. Jacobs, Kalispell, Mont.

The Even Exchange claim (Ag-Pb) is north of the Parnell and Board of Trade claims and west of the Nilson group. It is owned by Anton and Millie Seidl, Great Falls, Mont.

The Palmetto No. 2 claim is about 1-1/2 miles east of the Nilson group in the SW1/4 sec. 34, T. 15 N., R. 6 E. It was located June 7, 1889, by John W. Allen, et al. The Combination Gold Mining Co., c/o W. B. Carroll, Great Falls, Mont., is the present owner.

The Interocean claim is about three-fourths mile north of the Palmetto No. 2 claim in the NW1/4 sec. 34, T. 15 N., R. 6 E. It was located March 25, 1889, by Frank Marion, et al. Aaron R. Shull of Lewistown, Mont., is the present owner.

About 1937 or 1938 a small stamp mill was constructed by a man named Arbogast to mill gold ore from a claim northwest of the Gavander claims. According to G. W. Nilson, Great Falls, Mont., the mill was operated for a short time only and then dismantled. Nothing further was learned about the claim or its operation.

Thunder Mountain District

The Thunder Mountain district embraces an area on the north slopes of Thunder Mountain about 3 miles southwest of Monarch and about 4 miles northeast of the Carbonate district. The district's principal mining interest is its iron-ore deposits.

Thunder Mountain, the principal topographic feature, attains a maximum altitude of 8,000 feet. The main mass of this isolated mountain is a laccolith of granite porphyry, which intruded an area of limestones and micaceous shales. Erosion has removed the upper beds of the sedimentary rocks, exposing the core of the mountain and encircling sedimentary formations. Deposits of iron minerals occur along the contact of the granite porphyry and the sedimentary rocks on the northern slopes of Thunder Mountain. According to Weed (29), the sedimentary rocks locally have been baked and metamorphosed by the igneous intrustion; the soft micaceous shales were changed to hard, flinty, brittle hornstone. The iron ore is in part a replace ment of the sedimentary rocks; it occurs between them and the prophyry. The deposits are lens-shaped. They occur at irregular intervals over a distance of about 3 miles. According to Goodspeed (6), the iron minerals are mainly limonite, hematite, and magnetite; bands of these minerals up to 2 feet in thickness are interbedded with numerous thin layers of shale.

Eleven mining claims have been located end to end and along the contact of the igneous and sedimentary rocks. These claims, in two groups under separate ownership, contain all of the known iron deposits in the district. They are accessible only by a rough trail that leads to the claims from Monarch.

Albright (Fe)

The Albright holdings include the Albright, Last Chance, and Valley View claims on the western end of the grouping and the Mayflower, Roosevelt No. 2, Big Horn, Humbolt, and Iron King claims on the northeastern end. The claims were located in 1901 by Villa C. Albright. They were prospected extensively during the early days but have remained idle for many years. Mrs. Alice Shadoan, Livingston, Mont., is the present owner. No ore has been shipped.

The ore bodies, consisting mainly of limonite, hematite and magnetite, occur along the contact of granite porphyry and thin-bedded limestone and shale. On the first three claims at the west, the strike of the contact ranges from N. 68° E. to N. 85° E. The dip averages about 70° NW. On the four eastern claims the stike ranges from N. 73° W. to about N. 42° W. with the dip about 70° NE. One lens-shaped deposit exposed on the Valley View claim is reported by O. C. Mortson of Great Falls, Mont., to be 20 feet wide. A lens of about the same width occurs on the Humbolt claim. A lens on the Roosevelt No. 2 claim is reported to have a maximum width of 46 feet.

The deposits have been prospected by many pits, open cuts, and shallow shafts. An adit cuts one of the lenses about 125 feet below the outcrop.

According to C. W. Brazee of Monarch, Mont., who had a lease on the claims in 1942, the ore exposed in the adit is similar to that exposed in the surface workings.

According to Weed (27), analyses made for Albright showed the ore to contain 76.9 percent Fe_2O, 0.07 percent FeO, 0.03 percent MnO, 8.80 percent SiO , 0.74 percent Al_2O_3, 0.03 percent S, and 13.36 percent H_2O - total 99.93 percent. According to W. H. Albright of Helena, Mont., an analysis of a sample of ore made by the Western Steel Co., Chicago, Ill., showed it to contain 67.21 percent iron, a trace of phosphorus, and a trace of manganese.

The claims are at altitudes above 6,000 feet. A road formerly connected the properties with the railroad at Monarch, a distance of 3 to 4 miles. In recent years the railroad was removed. The old road now is impassable for cars or trucks. The deposits are accessible only by foot or on horseback. The old workings now are caved or otherwise inaccessible.

Hurricane and Tornado (Fe)

The Hurricane, Tornado, and Edna claims are about centrally located in respect to the 11 patented contiguous claims along the north slope of Thunder Mountain. The claims were located in 1887 and 1888 by Ethelbert J. Sanford, et al. They were known at one time as the Frank Marion group. Aaron R. Shull of Lewistown, Mont., is the present owner.

The iron deposits are similar in occurrence and character to those on the Albright claims adjoining at the east and west. They occur along the contact of a fine-textured granite porphyry and thin-bedded limestone and shale. The strike is about East, the dip about 72° N. The deposits are lens-shaped, ranging in width to a maximum of about 20 feet. A Bureau of Mines sample, taken in 1943 from an open-cut on the Tornado claim where the deposit was 18 feet wide, assayed 46.32 percent iron. Analyses of five samples taken in 1936 by C. W. Brazee of Monarch, Mont., averaged 52.9 percent iron. These samples also contained a small amount of copper, about 1 percent lead, and about 2 ounces silver a ton. According to Weed (27), the deposits were reported to contain $1.50 to $3.00 gold a ton.

Other Iron Deposits

J. F. Kemp in his book "The Ore Deposits of the United States" states: "An extensive bed of very excellent carbonate ore has been discovered with coal near Great Falls in the Sand Coulee region of Montana. Being near coal, limestone, and other iron ores, it promises to be of considerable importance." No further information regarding the deposit is available.

Gold Placers

A small amount of placer gold has been recovered from several gulches in the Neihart, Barker, and Logging Creek areas. Most of those gold placer deposits were worked many years ago on a small scale. They proved to be low grade and soon were abandoned. Small-scale manual operations have been conducted on Hoover Creek about 6 miles north of Neihart, on upper Pilgrim Creek north of the Carbonate district, on Snow Creek above its junction with Carpenter Creek, and on the Dry Fork of Belt Creek below the town of Barker.

Some small-scale operations were undertaken on the Missouri River about 5 miles southwest of the town of Cascade. The placer gold in this locality was extremely fine and difficult to recover.

The total production of placer gold in Cascade County from 1904 to 1948, inclusive, is reported to have been only 11.56 ounces valued at $239 (12).

NONMETALLIC MINERAL DEPOSITS

Nonmetallic (industrial) minerals have not been mined to any great extent in Cascade County, mainly because of the limitations of local markets. Limestone has been mined for smelter and sugar plant use. Gypsum was mined and processed some 35 years ago. Fire clay is being mined for use in the smelter at Great Falls. A hard, dense sandstone has been used in the construction of some local buildings. Deposits of bentonitic clay are found in a number of areas, but none of this clay has been utilized except by a few local farmers for lining irrigation ditches. A dike containing fine mica is reported near the town of Milligan. Kootenai shale and clay are mined and manufactured into brick near Great Falls. Sand and gravel are produced at a number of localities for highway and construction purposes.

Limestone

Limestone formerly was mined at a quarry in Belt Creek Canyon in sec. 22, T. 16 N., R. 6 E., about 9 miles by road northwest of Monarch. For many years this limestone was shipped to Great Falls for use in the smelters and to Chinook for use in a sugar factory. The quarry is owned by the Anaconda Copper Mining Co. It was operated at one time under lease by Matt Antonich of Monarch, Mont. No limestone has been mined since the branch line of the Great Northern Railroad from Armington to Neihart was removed in 1945.

According to Weed (27), the limestone occurs in the Madison formation. The thinly bedded limestones about midway in the series were quarried for quicklime production and for use as smelter flux. Analyses show it to be a very satisfactory rock for these purposes.

Weed also states that limestone nodules occurring in the clay beds above the coal seam near Belt were used locally for making quicklime.

Fire Clay

Fire clay, used mainly at the copper- and zinc-refining plants of the Anaconda Copper Mining Co. in Great Falls, is mined intermittently in sec. 31, T. 19 N., R. 7 E., about half a mile northeast of Armington. The clay occurs as a shale in a bed about 5 feet thick; it is interbedded with flat-lying, reddish sandstone of late Cretaceous age. This bed is about 150 feet above the coal seam that was mined extensively some years ago.

The deposit is owned by the Anaconda Copper Mining Co.; it is worked at intervals by J. O. Randall of Armington, Mont. The shale is mined underground. Room and pillar mining methods are used, the rooms being turned off from a main haulage adit that has been driven N. 25°W. into the bed for several hundred feet. The shale in place is dry and compact. It is ground in a pug mill and tempered before it can be used as a fire clay.

Gypsum

Gypsum was mined and processed in Cascade County from 1908 to 1915. The gypsum was mined from a deposit in secs. 13 and 24, T. 17 N., R. 6 E., about 1 mile east of Riceville. Riceville, on the now abandoned Neihart branch of the Great Northern Railway, is about 9 miles south of Armington. The deposit is on land owned by Wm. Gerhart. It formerly was owned by H. L. Robinson, who transferred the mineral rights and a right-of-way to Jones H. Hall by a deed dated August 30, 1909. The present owner of the mineral rights was not learned.

According to Perry (15), the first operations were conducted by the Mackey Plaster Co. This company was succeeded by the United States Gypsum Co. Adits were driven into the steep slope of the hills about 700 feet above Belt Creek. Room and pillar methods of mining were employed. The gypsum was hauled by wagon to Riceville, where it was shipped to a processing plant in Great Falls. The crude gypsum, after being crushed, was calcined into plaster, Markets for the plaster were mainly local but some plaster was shipped as far as Seattle, Wash. About 100,000 tons of gypsum is reported to have been shipped to Great Falls. Because of difficulties encountered in obtaining leases on lands other than the 40 acres then being mined, the United States Gypsum Co. transferred its operations to Heath, Mont. Much difficulty was experienced in mining the deposit because of its irregularity. Although it was 15 feet thick and without partings at one place in the mine, it pinched out in about 100 feet. Throughout most of the mine the bed averaged 4 to 6 feet in thickness. It had a general northwest dip of about 5°.

The gypsum in this area occurs interbedded with gray-green shale and sandstone near the top of the Otter formation of upper Mississippian age. All workings were caved and inaccessible when the properties were visited by Bureau of Mines engineers in June 1948.

Another gypsum deposit occurs on the Goodman ranch in sec. 1, T. 17 N., R. 6 E., about 3 miles north of Riceville. A processing plant was built on Belt Creek about 1 mile north of the Goodman ranch by the Aluminum Plaster Co. in 1900 (15). The deposit is on land now owned by Sidney Goodman, Armington, Mont. It was prospected by an adit driven eastward into the side hill for a distance of several hundred feet. Only lenticular masses and thin seams of gypsum were encountered. Two adits, 500 and 615 feet long, also were driven into the side of the bluff on the west side of Belt Creek. No commercial bodies of gypsum were developed by either of these adits. The processing plant was operated for a short time only on gypsum hauled by wagon from other properties east of Riceville (15). When visited in 1949, all of the adits had caved and were inaccessible.

Bentonite

Bentonitic clay occurs abundantly in Cascade County, particularly in the vicinity of the town of Vaughn about 12 miles northwest of Great Falls.

Outcrops of this material are exposed along the bank of an upper bench, which rises abruptly from the valley about 2 miles north of Vaughn. Erosion also has exposed the bentonite at many places in the bottom and sides of a small valley that extends into the bench about 4 miles northwest of Vaughn. Most of the small valley is included within the boundaries of the Fancus and other mining claims. These claims embrace an area of 520 acres in secs. 2 and 3, T. 21 N., R. 1 E. and secs. 34 and 35, T. 22 N., R. 1 E. They are held by location by Carl Lemmer, et al, of Great Falls, Mont.

The bentonite is interbedded with loosely compacted, shaly sandstone. Where exposed along the sides of the main highway, the bed averages about 4 to 5 feet in thickness. Farther west in the small valley the bed is more irregular and contains lenses up to 15 feet in thickness. The clay is not uniform in composition; it generally is of poor quality and contains considerable free sand and small lenses of shale. However, some of the clay appears to be a good quality of bentonite. Samples of some of the hard, shaly, unweathered material when immersed in water produces a gelatinous mass comparable with that produced by samples of some of the best quality South Dakota bentonite.

The deposits have not been developed for exploitation. Small amounts of the bentonite have been used by local farmers or ranchers for lining irrigation ditches. The claims, located by Lemmer, et al, are within a short distance of the branch of the Great Northern Railroad from Vaughn to Shelby. U. S. Highway 89 crosses the claims.

Building Stone

Hard, dense sandstone, which can be shaped readily for building purposes, occurs near Belt and Armington. It has been used in the construction of some buildings in these towns. This sandstone lies above the coal strata near the top of the Cascade formation. It occurs in layers 1 to 6 feet thick. In many places it is covered by only a small amount of overburden.

The buff-colored limestone along Belt Creek Canyon might be useful as a construction material.

Some of the massive granite porphyry in the vicinity of Neihart might be used as a building stone. It ranges in color from gray to pink. It is strong and tough; some of it will take a high polish. Its use as a substitute for eastern granite in monuments has been considered.

Mica

A mica deposit is reported to have been prospected many years ago on the west side of the Little Belt Mountains east of Milligan. According to Tom Short, White Sulphur Springs, Mont., a large amount of small-flaked mica occurs in a dark-colored dike.

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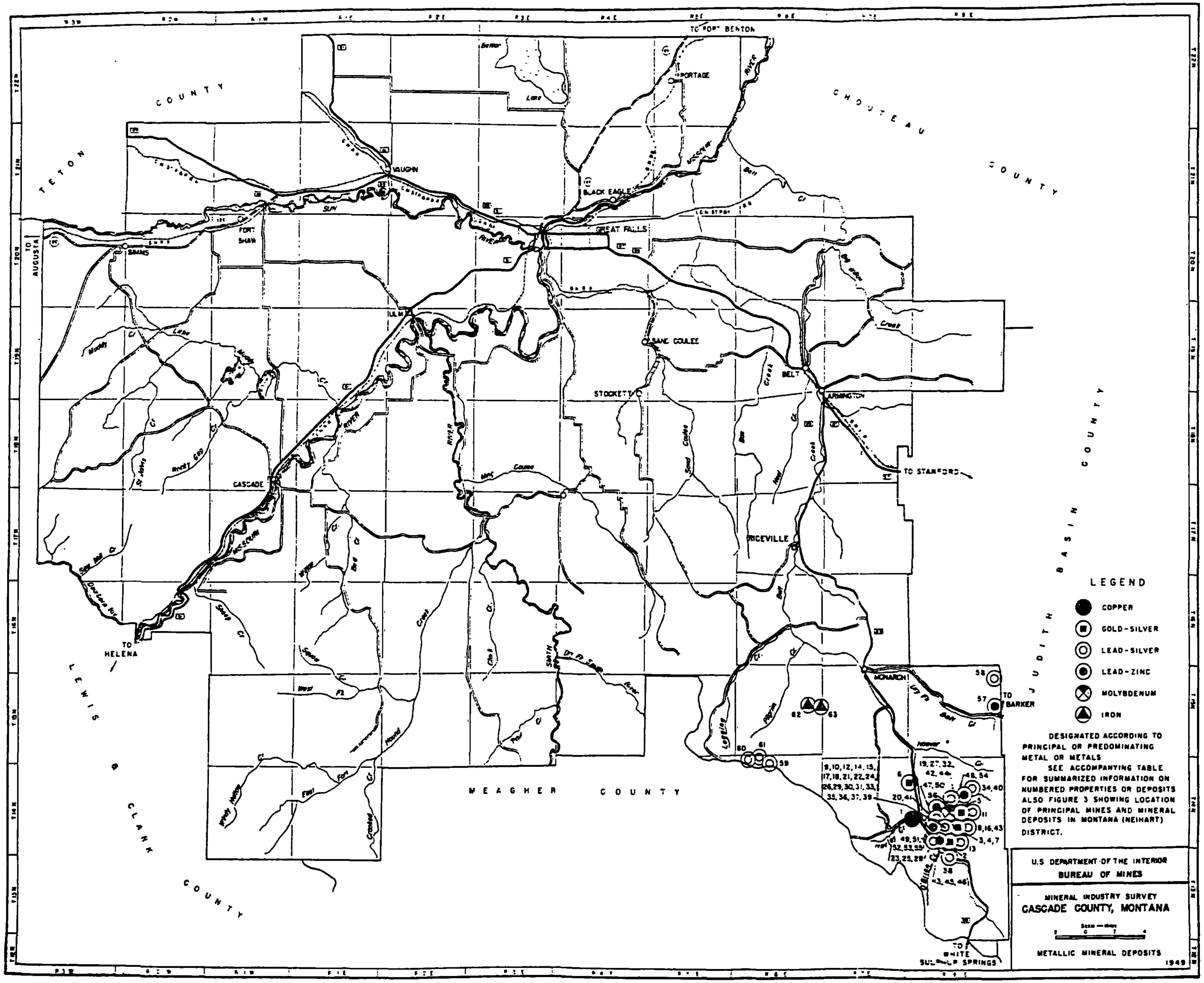

Figure 11. - Mineral industry survey map, Cascade County, Mont., showing location of metallic mineral deposits by symbols and reference numbers.

MINERAL INDUSTRY SURVEY TABLE
CASCADE COUNTY, MONT., 1949
Metallic Mineral Deposits 1/

Map ref. no.	Name of property or deposit a/	Location Sec.	Twp.	R.	Description of deposit	Indicated metal content	Reported production	Remarks
					- Copper			
Montana (Neihart) district								
1	Harley Creek (Imperial, Royal, & Granite Mt. groups)	19,30	14N	8E	Veins in granite porphyry. Chalcopyrite and some gold.	To 20% Cu, a little gold.	None	450-, 200-, and 225-foot adits. Idle for many years. Workings inaccessible.
					- Gold-Silver			
2	Bull of the Woods	33	14N	8E	Quartz-filled fissure in Neihart quartzite containing some sulfides, gold, and silver minerals.	?	Small amount of silver ore mined.	Shallow shaft now filled with debris.
3	Commonwealth, Spotted, & Lucky Strike	28	14N	8E	Two veins in Pinto diorite. To 2 feet in width. Local splitting. Gold and small amounts of silver sulfides, galena, chalcopyrite, and sphalerite.	Above average Au and Ag.	Some Au, Ag, Cu & Pb ore.	Two adits - inaccessible.
4	I.X.L. - Eureka	21,28	14N	8E	Disseminated shallow deposits in Snow Creek porphyry. Gold, sooty silver sulfide, some native silver, and manganese oxides. Some galena.	Above average Au, 10 to 15 oz. Ag.	1906-32 - 1,188 tons ore.	250-foot shaft - 2 levels - inaccessible. Intermittent operation. Idle since 1932. Had cyanide plant.
5	Lexington No. 2	22	14N	8E	Vein in gray gneiss. Heavy coarse pyrite containing some gold.	?	None	Short crosscut adit and drift - inaccessible. Referred to locally as the "iron mine"
6	LeRoy (Johannesburg)	7 12	14N 14N	8E 7E	Small quartz-filled fractures containing pyrite, limonite, gold, and a little chalcopyrite in silicified zones in hornblende gneiss.	Average about 0.20 oz. Au per ton.	None. About 800 tons oxidized ore on dumps.	500-foot shaft - several levels - inaccessible. 100-foot adit with several crosscuts - accessible. Idle for years. Report much low-grade ore
7	Spotted Horse	27	14N	8E	Vein in Pinto diorite and gneiss. A few inches to 3 feet wide. Altered country rock with narrow quartz stringer. Pyrite with gold, silver, little lead, zinc.	Selected ore to 1.02 oz. Au per ton.	Some ore reported to have been shipped.	Crosscut adit 120 feet with 200-foot drift. Partly accessible.
					- Lead-Silver			
8	Benton	27	14N	8E	A number of veins ranging to 6 feet in width in Pinto diorite and gneiss. Pyrite, galena, sphalerite, silver sulfides, gold, some chalcopyrite. Many claims - see report.	Some high-grade bands.	54,713 tons ore from 1905-48, incl. Ranked among main producers of district.	Four main adits - 500 to 1,600 feet, and a 600-foot adit on Big Snowy claim. Adits also on a number of other claims. Most of the older adits inaccessible. No activity since April 1948.
9	Big Seven	27,28	14N	8E	Main vein in Pinto diorite and gneiss overlain by quartzite. A few inches to 12 feet wide, average 5 to 6 feet. Heavy sulfide bands in altered mineralized country rock. Long ore shoots. Pyrite, silver sulfides, gold, galena, sphalerite, copper minerals.	Good average grade. Some high grade in Au, Ag.	143,274 tons ore 1902-42. One of district's larger producers.	Four main adits with drifts, crosscuts, winzes, etc. - extensive. Big Seven adit open - others generally inaccessible. See also Lexington and Tom Hendricks. Idle at present.
10	Black Bird	28	14N	8E	Three veins in Pinto diorite and gneiss. Quartz-filled fissures ranging to 2 feet in width. Sooty silver sulfides, galena, sphalerite, pyrite, some gold.	Some good ore in narrow bands.	579 tons ore 1915-21. Net smelter returns to 1935 reported at $33,960.	Main crosscut adit with short drifts on three veins. All accessible excepting south drifts. Inactive since 1935.
11	Black Diamond	22	14N	8E	Several veins in gneiss and diorite. Width not known. Silver sulfides, galena, a little zinc and antimony.	Indicated low-grade average.	Some production. Operated 50-ton mill for several years following 1910.	Several adits now inaccessible. Property idle for many years.
12	Blizzard	28	14N	8E	Small vein in fractional claim between Pennsylvania claim of Lexington group and Spotted claim.	?	Some high-grade silver ore reported to have been mined.	Shallow shaft on vein - not accessible.
13	Broken Hill	33	14N	8E	Vein in gneiss. Similar in character but narrower than the Broadwater vein.	High silver	769 tons ore shipped 1906-1921 by various lessees.	Workings inaccessible.
14	Champion "B"	29	14N	8E	Two paralleling veins in Pinto diorite. One vein 8 to 10 inches wide; other to 3 feet. Quartz containing galena, sphalerite, pyrite, cerussite, gold.	23 oz. Ag, 10% Pb, 7% Zn.	123 tons ore 1919-45.	Three adits, all inaccessible.
15	Concentrate & Monarch	29	14N	8E	Vein reported to be 3-1/2 feet wide containing silver sulfides, galena, and some gold.	?	One small shipment	Claims are in Florence group. 1,500-foot adit with 50 foot winze that encountered heavy flow of water. Idle since 1892

4022

MINERAL INDUSTRY SURVEY TABLE
CASCADE COUNTY, MONT., 1949
Metallic Mineral Deposits 1/(contd.)

◎ - Lead-Silver (contd.)

Map ref. no.	Name of property or deposit 2/	Location Sec.	Twp.	R.	Description of deposit	Indicated metal content	Reported production	Remarks
	Montana (Neihart) district (contd.)							
16	Cornucopia	22,27	14N	8E	Vein composed of about 12 inches of rusty quartz with 2 feet of altered diorite on each side. Narrow stringers of sulfides. Gold, silver, galena, sphalerite, pyrite, and a little chalcopyrite.	Sorted ore on dump - 1.46 oz. Au, 53.5 oz. Ag, 5.7% Pb, 13.8% Zn.	Small production. Too much zinc in ore in early days.	Three adits, a 300-foot shaft with 2 levels. All inaccessible. Long idle.
17	Cumberland	29	14N	8E	Vein in gneiss. May be same vein as that on Peabody claim at north.	?	Some high-grade ore reported mined some years ago.	400-foot adit - inaccessible.
18	Dacotah	28	14N	8E	Three veins - only one developed and mined. Dacotah vein in strong fissure in gneiss - 2 to 8 feet wide but narrower in Pinto diorite. Vein mainly of altered crushed country rock with bands and disseminations of pyrite, lead, zinc, and silver sulfides.	7 to 10% combined Pb and Zn, 1 to 3 oz. Ag.	More than 1,000,000 lb. Pb, nearly 3,000,000 lb. Zn with appreciable Ag, Au, and Cu from 1942-49. Ore milled in Florence mill.	Four adits from 100 to over 1,200 feet long. Also two others on other veins mined to small extent years ago. Operation suspended May 1949.
19	Double X "XX"	16	14N	8E	Vein following well-defined fracture along a porphyry-gneiss contact. Quartz, galena, sphalerite, silver sulfides, pyrite, and some chalcopyrite.	?	Small	300- to 500-foot adit and some shallow shafts - inaccessible. Last worked about 1934.
20	Eighty Eight "88"	20	14N	8E	Vein probably in diorite and gneiss. Details lacking. Silver sulfides, galena, sphalerite, chalcopyrite, cerussite in quartz and ankerite.	?	Small tonnage mined.	Upper adit. Lower adit about 1,700 feet long mostly in rock. Inaccessible. Little done since 1890.
21	Fairplay	28	14N	8E	Narrow vein in Pinto diorite. Silver sulfides, galena, sphalerite, pyrite, cerussite, considerable limonite.	Sorted ore: 20 to 74 oz. Ag, 11% Pb, 18% Zn.	125 tons of ore, 1919-26.	Short adit - inaccessible.
22	Florence	29	14N	8E	Four well-defined veins in gneiss. Concentrated vein 3-1/2 feet wide. Florence (main) vein 4 to 6 feet wide with splits. High-grade bands and streaks, sometimes filling full width of vein. Galena, sphalerite, pyrite, silver sulfides, some gold, copper minerals, in barite, ankerite, quartz.	15 to 25 oz. Ag, 5 to 6% Pb.	105,159 tons ore 1901 to 1943, incl. No records before 1901, but high-grade ore reported. A large producer.	Six adits. Two-compartment winze from lowest adit, 500 feet deep with 5 levels. Most of lower adit accessible. Winze and other adits inaccessible. Idle since 1943.
23	Frisco	29	14N	8E	Two narrow quartz-filled fissures in hard gneiss. Only one warranted development. Silver sulfides, galena, pyrite, and sphalerite.	Selected ore on dump - 52 oz. Ag, 33% Pb, 9.5% Zn.	No ore shipped.	625-foot adit driven in 1939 to explore what was considered to be southern extension of Equator vein. Adit accessible, raise from it has caved.
24	Galt	29	14N	8E	Four or more veins in Pinto diorite and gneiss. Main (Galt) vein only one mined. 1 to 20 feet wide. Altered crushed country rock with bands and lenses of sulfides-silver sulfides, galena, sphalerite, pyrite with barite, ankerite, and quartz.	At 950-foot depth - 20 oz. Ag, 4.5% Pb, 4.5% Zn. Some high grade.	800,000 oz. Ag up to 1920. 20,981 tons ore from 1901 to 1948, incl.	Two upper adits; lower one partly accessible. Also extension of Queen adit and of levels from Queen shaft, all now inaccessible. Some mining during 1949. First mine in Neihart district to pay dividends.
25	Graham & Hollowbush (S & R)	32	14N	8E	Vein composed mainly of silicified gneiss with sulfides mainly in irregular bands but some disseminated. Silver sulfides, pyrite, galena, sphalerite, and chalcopyrite. Some gold. Thought by some people to be extension of Broadwater vein.	Sample of material on dump - 2.5% Pb, 2.5% Zn, 4.3 oz. Ag. Some high-grade spots.	No early records. 5,536 tons ore from 1934 to 1943, incl.	Adit and 250-foot shaft with 2 levels. Heavy flow of water on 250-foot level. Not mined below. All workings inaccessible.
26	Hartley	29	14N	8E	Three or more veins in gneiss. Main No. 3 vein occupies well-defined fissure - a few inches to 4 feet in width. Main ore shoot 600 feet long. Banded. Silver sulfides, native silver, galena, sphalerite, pyrite in crushed gneiss with quartz, ankerite, barite.	Some secondary enrichment. Above average silver ore.	Large early production not of record. 64,423 tons ore from 1901 to 1940, incl. 1,523,426 oz. Ag, 3,894,755 lb. Pb.	Main adit about 1,000 feet long. Winze from adit 500 feet deep. Most of main vein above bottom level mined for length of about 400 feet. All workings inaccessible.
27	Hegener	16	14N	8E	Four or more veins in gneiss, diorite, and quartz porphyry. Vilipa vein most productive - silver, lead, zinc, copper, iron sulfides and gold. Cold Rock vein minerals the same with native copper and silver. Baker vein is low-grade mineralized zone containing mainly chalcopyrite.	Some high-grade silver ore.	Some small lots. Shipments in total value reported at $25,000 to $30,000.	400-foot adit and 115-foot shaft with 300-foot drift level on Vilipa; 100-foot shaft with 50-foot drift level, and 265-foot adit drift on Cold Rock; 165-foot adit drift and 100-foot X-cut on Copper Queen; 75-foot adit on Baker. All now inaccessible.

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					- Copper			
	Montana (Neihart) district							
1	Harley Creek (Imperial, Royal, & Granite Mt. groups)	19,30	14N	8E	Veins in granite porphyry. Chalcopyrite and some gold.	To 20% Cu, a little gold.	None	450-, 200-, and 225-foot adits. Idle for many years. Workings inaccessible.
					- Gold-Silver			
2	Bull of the Woods	33	14N	8E	Quartz-filled fissure in Neihart quartzite containing some sulfides, gold, and silver minerals.	?	Small amount of silver ore mined.	Shallow shaft now filled with debris.
3	Commonwealth, Spotted, & Lucky Strike	28	14N	8E	Two veins in Pinto diorite. To 2 feet in width. Local splitting. Gold and small amounts of silver sulfides, galena, chalcopyrite, and sphalerite.	Above average Au and Ag.	Some Au, Ag, Cu & Pb ore.	Two adits - inaccessible.
4	I.X.L. - Eureka	21,28	14N	8E	Disseminated shallow deposits in Snow Creek porphyry. Gold, sooty silver sulfide, some native silver, and manganese oxides. Some galena.	Above average Au, 10 to 15 oz. Ag.	1906-32 - 1,188 tons ore.	250-foot shaft - 2 levels - inaccessible. Intermittent operation. Idle since 1932. Had cyanide plant.
5	Lexington No. 2	22	14N	8E	Vein in gray gneiss. Heavy coarse pyrite containing some gold.	?	None	Short crosscut adit and drift - inaccessible. Referred to locally as the "iron mine"
6	LeRoy (Johannesburg)	7 12	14N 14N	8E 7E	Small quartz-filled fractures containing pyrite, limonite, gold, and a little chalcopyrite in silicified zones in hornblende gneiss.	Average about 0.20 oz. Au per ton.	None. About 800 tons oxidized ore on dumps.	500-foot shaft - several levels - inaccessible. 100-foot adit with several crosscuts - accessible. Idle for years. Report much low-grade ore
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9	Big Seven	27,28	14N	8E	Main vein in Pinto diorite and gneiss overlain by quartzite. A few inches to 12 feet wide, average 5 to 6 feet. Heavy sulfide bands in altered mineralized country rock. Long ore shoots. Pyrite, silver sulfides, gold, galena, sphalerite, copper minerals.	Good average grade. Some high grade in Au, Ag.	143,274 tons ore 1902-43. One of district's larger producers.	Four main adits with drifts, crosscuts, winzes, etc. - extensive. Big Seven adit open - others generally inaccessible. See also Lexington and Tom Hendricks. Idle at present.
10	Black Bird	28	14N	8E	Three veins in Pinto diorite and gneiss. Quartz-filled fissures ranging to 2 feet in width. Sooty silver sulfides, galena, sphalerite, pyrite, some gold.	Some good ore in narrow bands.	579 tons ore 1915-21. Net smelter returns to 1935 reported at $33,960.	Main crosscut adit with short drifts on three veins. All accessible excepting south drifts. Inactive since 1935.
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Reference No. 9

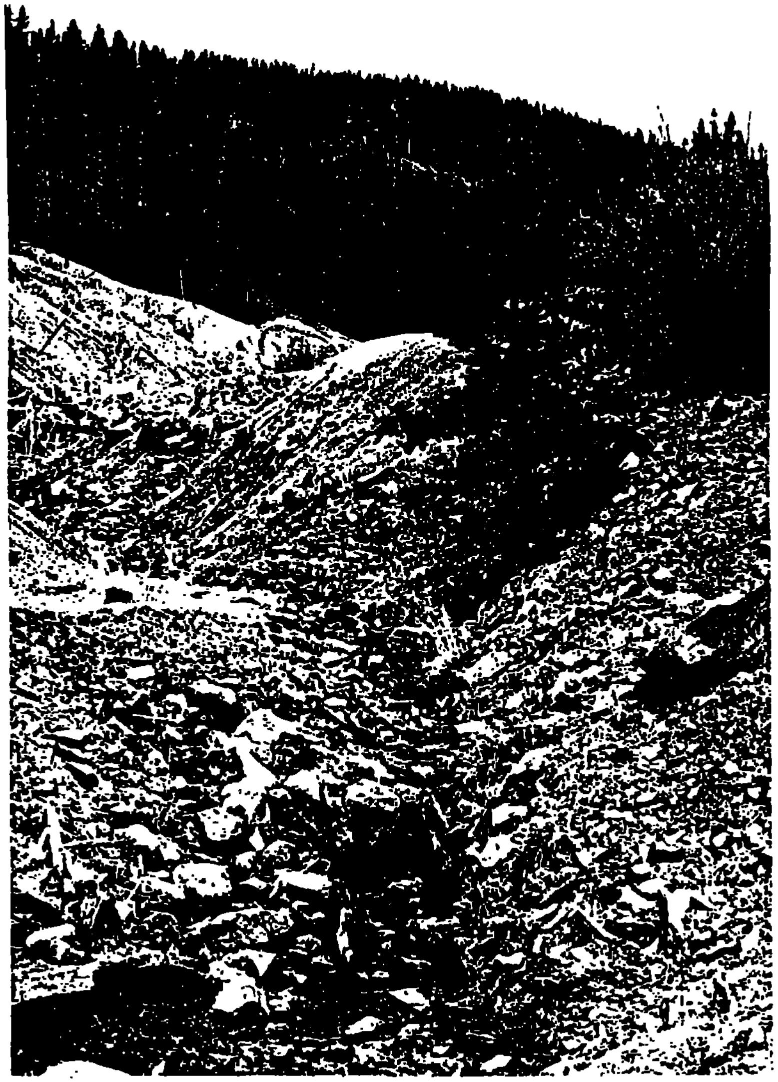


PHOTO 1
Silver Dyke Tailings piles bisected by unnamed tributary of Carpenter Creek.

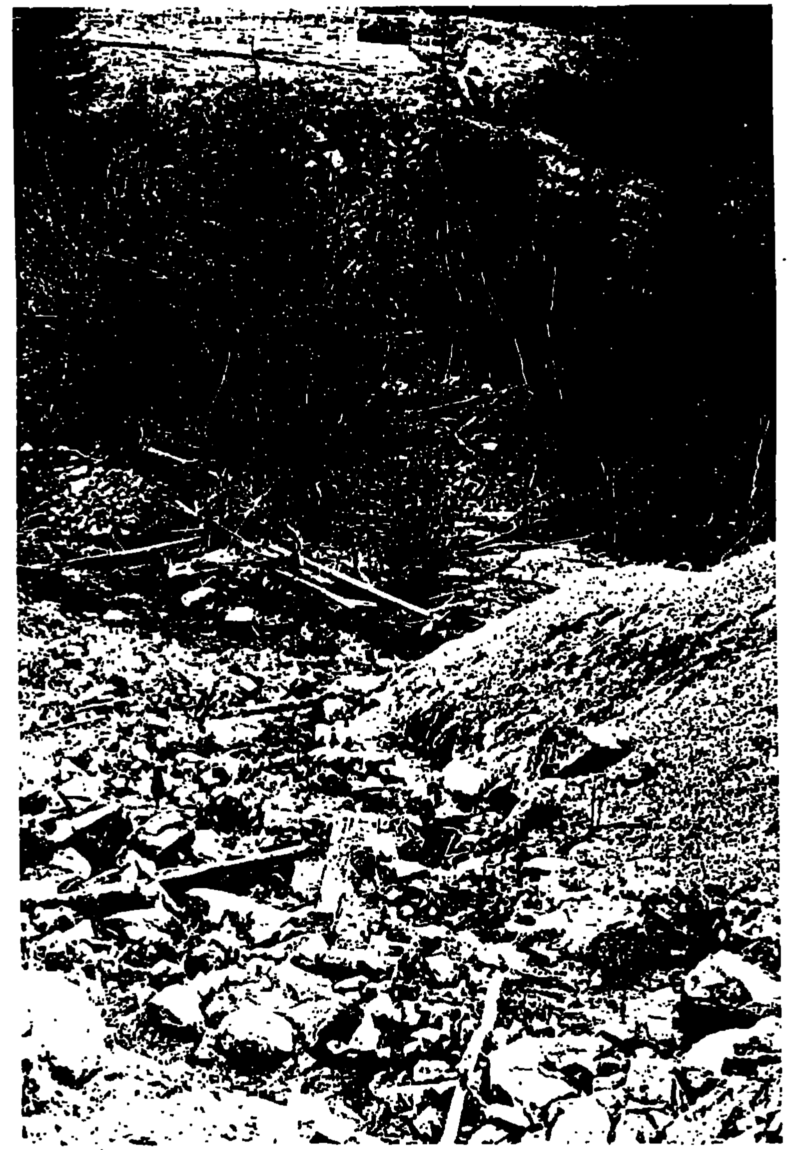


PHOTO 2
Unnamed tributary at the confluence of Carpenter Creak. Unnamed tributary and Carpenter Creek in contact with Silver Dyke tailings.

PHOTO 3
Carpenter Creek Tailings site with Carpenter Creek running through piles.

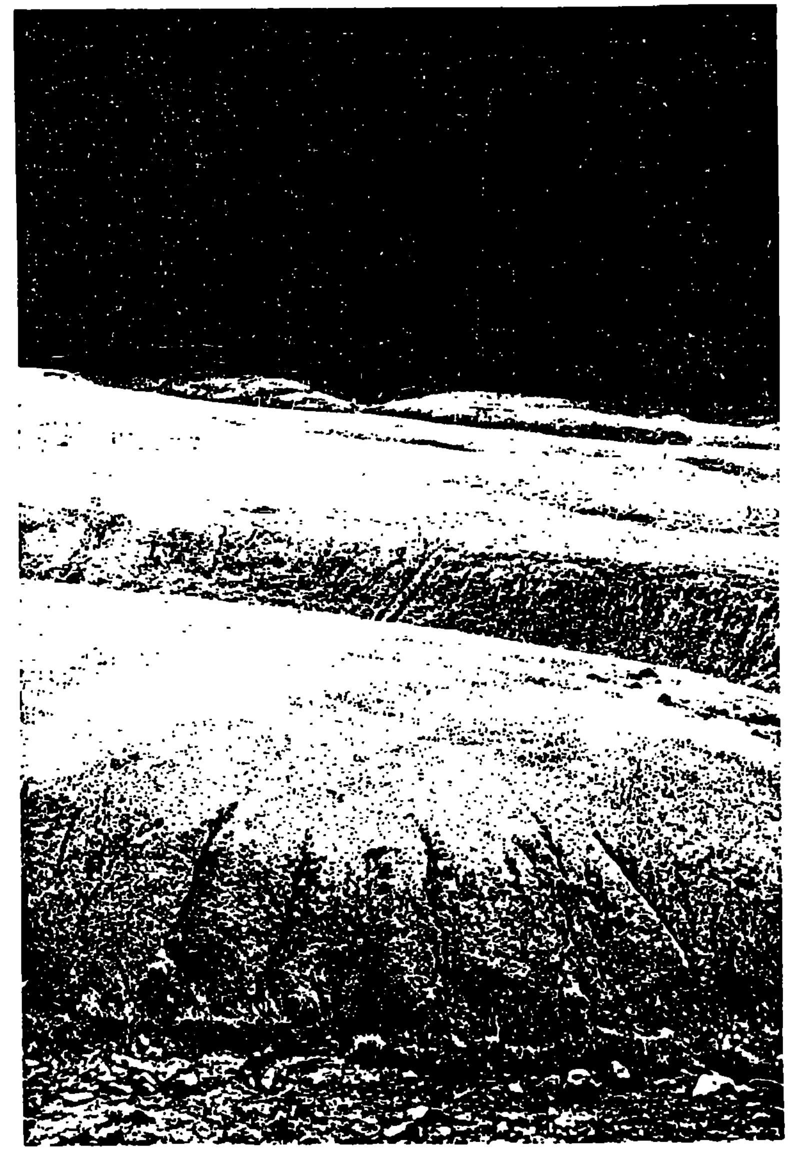


PHOTO 4
Carpenter Creek tailings piles with Carpenter Creek in the foreground. Note erosion gullies on tailings pile draining into Carpenter Creek.

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU

HAZARDOUS MATERIALS INVENTORY SITE INVESTIGATION LOG SHEET

Mine/Site Name: CARPENTER CREEK TAILINGS PA#: 07-103

Date: May 24 and 25, 1993 Time: 1245 / 0715

Field Team Leader: Tuesday, Pioneer

Sampling Personnel: Babits, Clark, Belanger, Flammang, Lasher; Pioneer Pierson, TD&H

Visitors: None

Weather/Seasonality Observations: Partly cloudy; slight breeze; 65°F; Carpenter Creek is running fairly full with lots of run-off crossing tailings; cool, wet spring weather.

Photographic Log (Film Roll and Photo No.'s/Video Tape Number): #1-#3: NE on lower Carp. Crk. Tails facing SW (Panorama); #4: Where surface water enters tails (E); #5: Surface water running across tails (S); #6: Surface water flowing across tails (NW); #7: Tributary creek entering Carp. Crk. (NW); #8: Same as #7 (W); #9: W end of tails-Tails dam-South; #10: Same as #9 and tails sluffing (SE); #11: Surface water drainage, (NE); #12: Carp. Crk. Tails washout (N); #13: Upper Tails (W end) dam (S); #14: Tributary creek entering Carp. Crk. overview (NE); #15: Tributary creek entering Carp. Crk.-Upper Tails (W end) (N); #16: Water drainage onto Upper Tails NE section of tails (SE); #17,18: Panorama shot of Upper Tails (SW) sitting on W end of tails; #19: Tributary creek on NE corner of Upper Tails (SE); #20: Same as #19 (NW); #21: Tributary creek entering Carp. Crk. and center of Upper Tails (NW); #22,23: Lower tails, panorama from road to East; #24-26: Upper Tails., panorama from road looking East-South. Video Tape No. 1

General Comments/Observations (not covered specifically in attached Inventory Forms): Present on the East side of Carp. Crk. approx. 6' bgs. is a 1' layer of black stained particles. Materials (sand & cobbles) appear to be coated with black substance. No hydrocarbon smell present at or near 07-103-SW-5 sampling site, SE-2 (XRF sample) site and 07-103-SW-1 site.

Other Hazardous Materials/Substances Present: N/A

General Comments on Potential Remedial Alternatives: Route surface water around or over tailings; pull back tailings from Carpenter Creek.

I. BACKGROUND INFORMATION

This information is to be collected to the extent practical prior to conducting the Site Investigation. Data gaps shall be filled in during the investigation.

Mine/Site Name(s): CARPENTER CREEK TAILINGS PA#: 07-103

Legal Description: T 14N ;R 8E ;Sec. 16 , SE1/4SW 1/4 ___ 1/4
Sec. 21 , NE1/4NW 1/4 ___ 1/4

County: CASCADE Mining District: NEIHART

Latitude: N 46° 58' 00" Longitude: W 110° 43' 01"

Primary Drainage Basin and Code: Belt Creek/10030105
Secondary Drainage Basin: Carpenter Creek

USGS Quadrangle map name(s): Neihart

Mine Type/Commodities: Mill Tailings
Activity Status: Active___,Inactive/Exploration___,Abandoned X .

Ownership status: Known YX N__; private/public? Private/Public
Owner, Agent, or Contact(Include address and phone when available): Amax Exploration; Lewis and Clark National Forest, P.O. Box 871, Great Falls, MT 59403.

Relationship to other mines/sites in the area/district: Down stream from several mines including Silver Dyke Mill. Tailings at Carp. Crk. are thought to originate from the Silver Dyke Mill.

Regulatory Status (Activity by other agencies)? Hardrock permits? Past Reclamation Activities? AMRB reclamation planning.

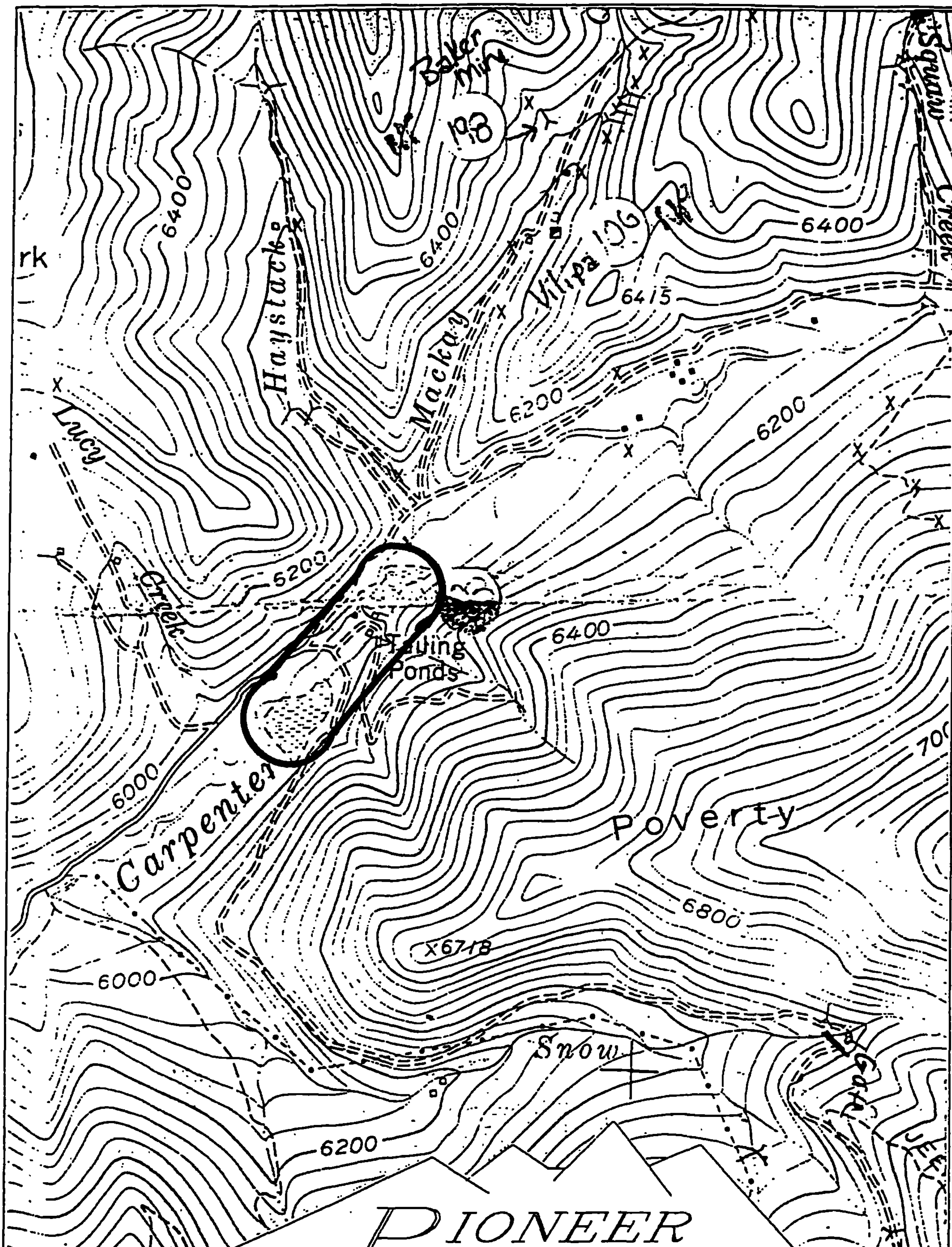
General site features: Elevation 5900' ,Slope Very gentle ,
Aspect Southwest

Land use: Mining___, Recreational X , Residential___, Urban___,
Agricultural___, Other(Specify)___

Area of disturbed/unvegetated lands? 15.6 acres.
Dimensions: Lower pond, 360,000 ft^2; upper pond, 320,000 ft^2.

Predominant vegetation types: On tails.: none to some snake grass colonizing surrounding area; Lodgepole pine on slopes; willows in stream floodplain.

Access: roads - good X ,poor___,4wd___,trail___.
Other logistical considerations (proximity to other sites). Big Seven mine further up Snow Creek Road; Silver Dyke Complex further up (1.5 miles) Carp. Crk. Road; Baker, Vilipa, and Sherman #2 all within 1 mile of site.



CARPENTER CREEK TAILINGS, P.A. NO. 07-103

T14N, R08E, SECTIONS 16, 21

SCALE: 1" = 1000'

Montana Bureau of Mines and Geology
Water Well Log Data

10/22/1993

Well No.	Location	Depth	Yield	Static Water Level
M:123062	14N 08E 20 DBA	41.0	4.0	24.00
M:123061	14N 08E 20 DBA	40.0	7.0	0.00

Well logs within 1 mile radius; water rights 15 mi downstream (Attach MBMG Well Log Printout(s): There are 2 well logs within a 1 mile radius.

General site geologic, hydrologic, and hydrogeologic settings (Also note presence of radioactive minerals). Carp. Crk. Tails. lies on the alluvium in the floodplain of Carp. Crk. Ore occurs as veins in gneisses or schists or at contact with later intrusives. Veins have high silver content; deeper levels contain large quantities of lead and zinc.

Mining/milling history, ore type/tenor, host rock, gangue: Carp. Crk. tailings ponds probably functioned as tailings ponds for the Silver Dyke Mine and Millsite upstream. Remnants of an apparent flume are visible in upper tailings. Mining at Silver Dyke began in 1923 through 1929. Tailings ponds were present in 1935.

Mine Operation?

Shafts -	Yes___,	No X,	# ____,	Comment
Adits -	Yes___,	No X,	# ____,	Comment
Pits -	Yes___,	No X,	# ____,	Comment
Placers -	Yes___,	No X,	# ____,	Comment
Other -	Yes X,	No____,	# 2,	Comment Tailings ponds

Mill Operation? Yes____, No X. If yes answer the next three questions: (Impoundment only)

Period(s) of Operation: Received tailings 1921-1929

Origin of Ore Milled - Custom Mill___ Dedicated Mill___; Number and names of mines that supplied mill feed: Silver Dyke Mill

Process? Hg-amalgam, CN⁻ leach (vat, heap), floatation, smelting? Floatation

II. INFORMATION COLLECTED ON SITE

A. SOLID MATRIX WASTE CHARACTERIZATION

1. Waste Characteristics - Use table on following page.

Unique source identification (e.g. west waste rock dump #2) and abbreviation on sketch map and source list (e.g. WWRD2). Locate source on sketch map with any measured distances from at least two landmarks.

Source types: Waste rock dumps and piles (WR); tailings impoundments and piles (TAIL); vats, vessels, tanks that contain something (VAT); barrels - not empty (BAR); soils contaminated by spills or leaks (SP); suspected asbestos containing materials (ACM); garbage/refuse/junk dumps (DMP); other sources (OTH).

Source size: Estimated volumes (cu. yards or feet, # of barrels) for each source identified above.

Location/Description: List location and description for each source identified above.

Waste containment: Is the source contained with respect to groundwater, surface water, and airborne releases or the potential to release? Good, adequate, poor, or none. Are waste structures / vessels sound, are runon/runoff controls in place, are wastes covered or vegetated, pond liners intact?

2. TAILINGS IMPOUNDMENTS - If tailings impoundments are also present, complete the following questions.

Describe the tailings grain size distribution(approximate % sand, silt, & clay): Interbedded from med. sand to clay size; 50% sand, 30% silt, 20% clay.

Determine tailings impoundment depth and describe stratification of the tailings if observable(based on texture and color): Bottom not reached; over 15' deep at toe, > 9' in center. Reduced zone observed-gray color correlates with saturated zone; approx. 0.5-1' in saturated tails.

Are tailings wet or dry (Describe location of partially wetted tailings impoundments): Mostly wet at this time of year during the investigation; runoff flowing over tailings.

Describe condition of the tailings impoundment(Note condition of dams or structures, location of breaches): Poor to nonexistent; wood/pole dam with no side containment.

Comments on potential for mitigation: Simple runon/runoff control and isolation from Carp. Crk. would go a long way toward reducing problems; unstable toe should be reinforced; tails could be covered since they blow when dry.

SOURCE INVENTORY FORM

SAMPLERS: Tuesday, Lasher, Clark, Belanger

SOURCE I.D. NO.	SOURCE TYPE	SOURCE VOLUME (yd^3)	LOCATION/DESCRIPTION	CONTAIN-MENT	pH SU (D/S)*	RADIO-ACTIVITY (Mr/HR)	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
LT-1A	TAIL	60,000	Site 1 lower pond; borehole, 0'-3'	Poor	5.2 (D)	0.05	07-103-LT-1	05/24/93 1830	T-Metals, CN, ABA
LT-1B	TAIL		Site 1 lower pond; borehole, 3'-6'	Poor	4.6 (D)	0.03	N/A	N/A	XRF Analysis
LT-1C	TAIL		Site 1 lower pond; borehole, 6'-9'	Poor	3.7 (D)	0.04	N/A	N/A	XRF Analysis
LT-1D	TAIL		Site 1 lower pond; borehole, 9'-12'	Poor	4.0 (D)	0.04	07-103-LT-2	05/24/93 1830	T-Metals, CN, ABA
LT-2A	TAIL		Site 2 lower pond; borehole, 0'-3'	Poor	5.0 (D)	0.05			
LT-2B	TAIL		Site 2 lower pond; borehole, 3'-6'	Poor	5.6 (D)	0.04	N/A	N/A	XRF Analysis
LT-2C	TAIL		Site 2 lower pond; borehole, 6'-9'	Poor	4.2 (D)	0.05	N/A	N/A	XRF Analysis
LT-2D	TAIL		Site 2 lower pond; borehole, 9'-12'	Poor	< 3.5 D	0.04			
LT-3A	TAIL		Site 3 lower pond; borehole, 0'-3'	Poor	4.8 (D)	0.05			
LT-3B	TAIL		Site 3 lower pond; borehole, 3'-6'	Poor	4.0 (D)	0.03	N/A	N/A	XRF Analysis
LT-3C	TAIL		Site 3 lower pond; borehole, 6'-9'	Poor	4.8 (D)	0.04			
LT-4A	TAIL		Site 4 lower pond; borehole, 0'-3'	Poor	4.8 (D)	0.05			
LT-4B	TAIL		Site 5 lower pond; borehole, 3'-6'	Poor	5.0 (D)	0.05			
LT-4C	TAIL		Site 4 lower pond; borehole, 6'-9'	Poor	NM	NM	N/A	N/A	XRF Analysis
LT-5A	TAIL		Site 5 lower pond	Poor	NM	NM	N/A	N/A	XRF Analysis

*D-Direct reading(Kelway Meter); S-Saturated Paste(Orion Meter)

Comments or deviations from SOPs: 07-103-LT-1 is composite of LT-1A, -2A, -3A, and -4A. 07-103-LT-2 is composite of LT-1D, -2D, -3C, and -4B.
NM = Not Measured

SOURCE INVENTORY FORM (Cont'd)

SAMPLERS: Tuesday, Lasher, Clark, Belanger

SOURCE I.D. NO.	SOURCE TYPE	SOURCE VOLUME (yd^3)	LOCATION/DESCRIPTION	CONTAIN-MENT	pH SU (D/S)*	RADIO-ACTIVITY (mR/HR)	LAB. SAMPLE NO.	DATE/TIME	ANALYSES
UT-1A	TAIL	51,000	Site 1 upper pond; 0'-3', brown sand	Poor	6.0 (D)	NM	N/A	N/A	XRF Analysis
UT-1B	TAIL		Site 1 upper pond; 3'-6', brown sand	Poor	4.1 (D)	0.03	07-103-UT-1	05/25/93 1230	T-Metals, ABA, CN-
UT-1C	TAIL		Site 1 upper pond; 6'-9', brown sand	Poor	4.4 (D)	NM	N/A	N/A	XRF Analysis
UT-1D	TAIL		Site 1 upper pond; 9'-12', gray sand	Poor	4.2 (D)	0.04	07-103-UT-2	05/25/93 1230	T-Metals, ABA, CN-
UT-1E	TAIL		Site 1 upper pond; 12'-15', gray sand	Poor	5.0 (D)	NM	N/A	N/A	XRF Analysis
UT-2A	TAIL		Site 2 upper pond; 0'-3', brown sand	Poor	5.0 (D)	0.06			
UT-2B	TAIL		Site 2 upper pond; 3'-6', some gray sand	Poor	NM	0.055	N/A	N/A	XRF Analysis
UT-2C	TAIL		Site 2 upper pond; 6'-9', gray sandy clay	Poor	6.8 (D)	0.04			
UT-2D	TAIL		Site 2 upper pond; 9'-12', black	Poor	NM	0.04	N/A	N/A	XRF Analysis
UT-3A	TAIL		Site 3 upper pond; 0'-3', brown sand	Poor	5.0 (D)	0.03	N/A	N/A	XRF Analysis
UT-3B	TAIL		Site 3 upper pond; 3'-6'	Poor	5.8 (D)	0.04			
UT-3C	TAIL		Site 3 upper pond; 6'-9', gray sand	Poor	4.0 (D)	0.035			

*D=Direct reading(Kelway Meter); S=Saturated Paste(Orion Meter)

Comments or deviations from SOPs: 07-103-UT-1 is composite of UT-1B, -2A, and -3B. 07-103-UT-2 is composite of UT-1D, -2C, and -3C.

B. GROUNDWATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map or topographic map.

Flowing adits: Yes___, No_X_, Number:____ Identification:____________

Filled shafts: Yes___, No_X_, Number:____ Identification:____________

Seeps/Springs: Yes_X_, No____, Number:_____ Identification: Seep is present in the northeastern corner of the lower tailings pond.

Groundwater wells within 4 miles?: Yes_X_, No___;
Number of well logs: 27

Distance to nearest well used for drinking? Residence located approx. one mile below the site; not directly downgradient.

Sample types: Flowing adits (AD); filled shafts (SH); Residential wells (RW); Monitoring wells (MW); Seeps/Springs (SP).

Field Measurements: Flow (measured or estimated), pH (meter), Eh (meter), SC (meter), temperature (meter), Alkalinity (test kit)?

Potential for groundwater contamination (explain)?
Definite____, Probable_X_, Possible____, Unlikely____.
Groundwater present in tailings boreholes. Tailings contain elevated levels of heavy metals.

Other observations/notes: The nearest well is located on the opposite side of Carpenter Creek from the site and up slightly on hillside; approx. 1 mile downstream from site.

GROUNDWATER INVENTORY FORM

SAMPLERS: ______________________________

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SOURCE	FLOW* cfs/gpm	pH SU	SC µS/cm @ 25°C	Eh mV	Temp °C	ALK mg/L as $CaCO_3$	Depth ft	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
No samples were taken.												

FLOW: Estimated (E) or Measured (M) from adit, shaft, seep or spring?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): ______________________________

C. SURFACE WATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map or topographic map. Indicate drainage patterns (run-on/runoff) and directions on sketch maps.

Flowing streams: Yes X , No ___, Name(s): Carpenter Creek; Unnamed tributaries crossing Carpenter Creek Tailings and emptying into the creek.

Dry streambeds: Yes ____, No X , Name(s): ____

Other surface water: Yes X , No ___, Name(s)/Description: One pond on south side of lower tailings pond, fairly small (25'x25'); water drains out of pond and onto lower tailings pond.

Waste materials within any floodplain: Yes X , No ___ Source ID(s): Carpenter Creek bisects both tailings ponds.

Approximate Flood frequency? X 1 yr, ___10 yr, ___100 yr

Estimated seasonal flow of stream(s) (cfs)? Spring flow is 60.2 cfs.
High Flow: 70 cfs , Average Flow: 5 to 10 cfs

Distance between waste source(s) and nearest surface water body (ft)? 0 feet; Carpenter Creek dissects upper and lower tailings ponds, surface water flows over ponds in channels.

Surface water draining onto or through waste sources: Yes X , No ____,
Describe: Runoff flowing across tailings in well-defined channels; two of the larger channels may contain water all year.

Surface water use within 15 miles downstream? (Drinking water supply, irrigation, residential use? Sensitive environments within 15 miles downstream? Park, Wilderness, Fishery, Wetland, T&E habitat?)
Fishery (Belt Creek), wetlands, possible irrigation.

Observed erosional/sedimentation/stream turbidity problems? Yes X ,
No _____, Distance downstream (ft)? 1000' Describe/explain (Note streambank stability and condition of streambank vegetation and any manmade structures or channel changes present):
Tailings are entrained in streambank on both sides to a depth of at least 6' bgs for at least 1/2 mile downstream. Release of tailings into Carpenter Creek observed during storm event.

SURFACE WATER INVENTORY FORM

SAMPLERS: Babits, Flammang

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SAMPLE LOCATION	pH SU	SC µS/cm at 25°C	Eh mV	Temp °C	ALK. mg/L as $CaCO_3$	Flow cfs/gpm	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
SW-1	SW	Above confluence of Snow Crk. in Carpenter Creek	7.97	90	N/A	6.5	14	37.5 cfs (M)	07-103-SW-1	05/24/93 1900	T-Metals, TDS, Hardness, NO2/NO3, SO4, Cl
SE-1	SE	Just above conf. with Snow Crk. approx. 730' from SE-2	N/A	N/A	N/A	N/A	N/A	N/A	07-103-SE-1	05/24/93 1535	T-Metals
SE-1A	SE	Just above conf. with Snow Crk. approx. 730' from SE-2	6.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	XRF Analysis
SE-2	SE	1000' from base of lower tailings pond	5.6	N/A	N/A	7.8	N/A	N/A	N/A	N/A	XRF Analysis
SW-3	SW	At PPE of lower tailings pond	6.4	70	N/A	7.8	17	NM	07-103-SW-3	05/24/93 1615	T-Metals, TDS, Hardness, NO2/NO3, SO4, Cl
SE-3	SE	At PPE of lower tailings pond	3.8	N/A	N/A	N/A	N/A	N/A	07-103-SE-3	05/24/93 1615	T-Metals
SW-4	SW	At PPE of upper tailings pond	8.13	70	N/A	7.9	16	NM	07-103-SW-4	05/24/93 1715	T-Metals, TDS, Hardness, NO2/NO3, SO4, Cl
SE-4	SE	At PPE of upper tailings pond	6.4	N/A	N/A	N/A	N/A	N/A	07-103-SE-4	05/24/93 1715	T-Metals
SW-5	SW	Upgradient of upper tailings	8.7	20	N/A	N/A	16	NM	07-103-SW-5	05/24/93 1745	T-Metals, TDS, Hardness, NO2/NO3, SO4, Cl
SE-5	SE	Upgradient of upper tailings	6.0	N/A	N/A	N/A	N/A	N/A	07-103-SE-5	05/24/93 1745	T-Metals

FLOW: Estimated (E) or Measured (M)?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): Flow measured only at SW-1 due to unsafe high-flow conditions.

D. ACID MINE DRAINAGE (AMD) POTENTIAL

Evaluate each source in table on next page.

AMD Characteristics:

Presence and abundance of sulfides? (SO_3)

Presence of evaporative salt deposits? (ESD)

Discolored or turbid seepage? (SPG)

Presence of long filamentous algae in drainages, mosses in moist areas?

Presence of ferric hydroxide precipitates? (FEOX)

Presence of burned or stressed vegetation? (VEG)

pH ≤ 5.0 (pH)

General Potential for AMD Mitigation:

Area available for treatment (acres)? Two acres - wetlands present below both ponds already.

Wetlands present: Yes X, No ___, Describe: Below toe of lower and upper dam, water is seeping out down drainage. Algae and ferric hydroxide precipitate were noted in lower pond seepage.

Carbonate rocks/soils: Yes ___, No X, Describe: ___

E. AIR PATHWAY CHARACTERISTICS

Population within 4-mile radius: 1-10 ___; 10-30 ___; 30-100 X; 100-300 ___; 300-1,000 ___; 1,000-3,000 ___; 3,000-10,000 ___; 10,000 or greater ___; Comments ___

Nearest residence(ft or miles)? 1 mile west on Carpenter Creek Road

For each source (table next page):

Available fine materials? Surface area?

Uncovered and unvegetated? Wet or dry?

Overall dust propagation potential:
observed high moderate low none

ACID DRAINAGE/AIR PATHWAY INVENTORY FORM

SAMPLERS: ____________________

SOURCE I.D. NO.	ACID MINE DRAINAGE CHARACTERISTICS (LIST)	MOISTURE CONTENT (WET/DRY/PARTIAL)	SURFACE AREA (SQUARE FEET)	UNCOVERED/UNVEGETATED AREA (PERCENT)	AVAILABLE FINES (YES/NO)	DUST PROPAGATION POTENTIAL (OBSERVED/HIGH/MODERATE/LOW/NONE)
LT	Filamentous algae; FEOX precipitate below pile	Wet	360,000	270,000	Yes	High
UT	FEOX below in wetlands	Wet	319,500	223,650	Yes	High

Notes and Clarifications: ____________________

F. DIRECT CONTACT CHARACTERISTICS

Residents or workers within 200 feet of sources: Yes____, No_X_,
Describe:____________________

Population within 1 mile: 1-10___; 10-30_X_; 30-100___; 100-300___;
300-1,000___; 1,000-3,000___; 3,000-10,000___; 10,000 or greater___;
Comments____________________

Evidence of recreational use on site: Yes_X_, No___, Describe: Clay pigeons from skeet shooting.

Accessibility - Fences, warning signs, closed roads? Unrestricted

Sensitive environments on-site or adjacent to site:

State or National Parks - Yes___, No_X_, Comment____________
Wilderness Area - Yes___, No_X_, Comment____________
T&E Species Habitat - Yes___, No_X_, Comment____________
Bat Habitat - Yes___, No_X_, Comment____________

Primary Drainage___; Secondary Drainage_X_; No Information___:

Riparian Habitat Quality - High___, Medium_X_, Low___
Wetlands Frontage - High___, Medium___, Low_X_
Fisheries Habitat and Species Classification - _6_
Sport Fishery Classification - _6_

G. SAFETY CHARACTERISTICS

Verify completeness of AMRB Inventory

Hazardous openings: Yes___, No_X_, Number____, types and locations:___

Hazardous structures: Yes_X_, No___, Number____, types and locations: Several old abandoned cabins located between the upper and lower tailings ponds.

Unstable highwalls, pits, trenches, slopes: Yes___, No_X_, Number____,
types and locations:____________________

Unstable waste piles, impoundments, undercut banks: Yes_X_, No____,
Number_2_, types and locations: Dam faces on both ponds are steep and have numerous logs and sticks protruding from their faces; faces are approx. 30 feet tall, actively mass wasting.

Fire and/or Explosion hazards: Yes_X_, No___, Explain: Cabins

Bibliography

MBMG, Geology and Ore Deposits of the Neihart Mining District, Cascade County, Montana, Memoir No. 13, Montana School of Mines, Butte, Montana, Written by Paul A. Schafer, July, 1935.

MBMG, Well Log Database, September 8, 1993.

MDFWP, Montana Rivers Information System Rivers Report, Version 2.0, Prepared by Montana Natural Resource Information System, December 1989.

MDSL/AMRB, Environmental Assessment Analytical Data for Carpenter Creek Tailings, Prepared by MSE, Inc., October 29 and November 15, 1990.

MDSL/AMRB Files, Abandoned Mine Reclamation Inventory Field Form for the Carpenter Creek Tailings, Prepared by Chen-Northern, September 8, 1989.

MSE, Inc., Environmental Assessments for Carpenter Creek Tailings site and Neihart Mining District, February 15, 1991.

USBM, Mines and Mineral Deposits (Except Fuel), Cascade County, Montana, Information Circular 7589, Written by Almon F. Robertson, Completed in April, 1950.

USGS, Topographic Map, Neihart, Montana, 7 1/2 minute Quadrangle, 1961.

LABORATORY ANALYTICAL DATA

CARPENTER CREEK TAILINGS
PA NO. 07-103

MDSL AMRB/PIONEER 4/9/93

17

Carpenter Creek Tailings PA# 07-103

AMRB HAZARDOUS MATERIALS INVENTORY
INVESTIGATOR: PIONEER-TUESDAY
INVESTIGATION DATE: 6/24/93

SOLID MATRIX ANALYSES

Metals in soils — Results per dry weight basis

FIELD ID	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/Kg)
07-103-LT-1	61.4	927	24.1	11	14.9 J	3450	42600	0.095 J	4720	31.9	7870	4.21 UJ	2370	1.16 U
07-103-LT-2	25.1	2820	30.6	5.49	9.22 J	2740	28600	0.071 J	3950	24.9	4940	3.59 UJ	2150	1.072 U
07-103-SE-1	73	1100	20.3	12.2	13.7 J	3440	43900	0.071 J	4090	30.7	9540	3.99 UJ	1790	NR
07-103-SE-3	139	905	34.2	21.5	11.5]	3740	49500	0.062 J	4360	36.8	18500	4.06 UJ	1960	NR
07-103-SE-4	46.6	737	25.0	10.2	15.2 J	2670	36000	0.106 J	5030	34.7	6840	3.66 UJ	2090	NR
07-103-SE-5	34.5	168	12.4	8.72	9.27 J	2910	28000	0.045 J	2100	16.7	5100	3.33 UJ	1090	NR
07-103-UT-1	69.8	663	28.0	11.3	19.2	2850	47500	0.015 U	6830	45.8	4620	5.27 J	2990	1.194 U
07-103-UT-2	36.8	1200	21.3	9.93	16.1	1950	40700	0.019 U	6870	45.4	3750	5.24 J	2050	1.231 U
BACKGROUND	10.5	131	1.4	6.83	22.2	26.1	20600	0.048 U	607	15.6	667	3.39 UJ	548	NR

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Acid/Base Accounting

FIELD ID	TOTAL SULFUR %	TOTAL SULFUR ACID BASE t/1000t	NEUTRAL. POTENT. t/1000t	SULFUR ACID BASE POTENT. t/1000t	SULFATE SULFUR %	PYRITIC SULFUR %	ORGANIC SULFUR %	PYRITIC SULFUR ACID BASE t/1000t	SULFUR ACID BASE POTENT. t/1000t
07-103-LT-1	1.21	37.8	25.1	-13	0.09	0.5	0.61	15.9	9.16
07-103-LT-2	0.5	15.6	16.1	0.43	0.2	0.15	0.15	4.69	11.4
07-103-UT1	0.42	13.1	23.4	10.3	0.07	0.05	0.30	1.56	21.9
07-103-UT2	0.57	17.8	21.2	3.40	0.12	0.13	0.32	4.06	17.1

WATER MATRIX ANALYSES

Metals in Water — Results in ug/L

FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC. (mg CaCO3/L)
07-103-SW-1	2.6	18.6	4.13	5.99 U	8.53 J	62.9 J	174	0.064 J	243	8.78 U	42	18.3 U	560	32.8
07-103-SW-3	2.17	18.3	4.5	5.99 U	5.1 J	62.2 J	226	0.15 J	249	8.78 U	45.6	18.3 U	549	32.9
07-103-SW-4	2.58	14.9	4.4	5.99 U	5 U	54.9 J	127	0.088 J	244	8.78 U	24.8	18.3 U	539	30.2
07-103-SW-5	2.81	15.8	3.37	5.99 U	6.67 J	56.2 J	148	0.083 J	252	9.57	30.4	18.3 U	526	28.4

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Wet Chemistry — Results in mg/l

FIELD I.D.	TOTAL DISSOLVED SOLIDS	CHLORIDE	SULFATE	NO3/NO2-N	CYANIDE
07-103-SW-1	83	< 5.0	14	< 0.05	NR
07-103-SW-3	85	< 5.0	17	< 0.05	NR
07-103-SW-4	74	< 5.0	14	< 0.05	NR
07-103-SW-5	74	< 5.0	10	< 0.05	NR

LEGEND

- LT1 - Composite of subsamples LT-1A, -2A, -3A, and -4A.
- LT2 - Composite of subsamples LT-1D, -2D, 3C, and 4B.
- SE1 - Just above confluence of Carpenter Creek with Snow Creek approximately 730 feet from SE1.
- SE3 - At PPE of lower tailings pond in Carpenter Creek.
- SE4 - At PPE of upper tailings pond in Carpenter Creek.
- SE5 - Upgradient of upper tailings pond in Carpenter Creek.
- UT1 - Composite of subsamples UT1B, 2A, and 3B.
- UT2 - Composite of subsamples UT1D, 2C, and 3C.
- BACKGROUND - From Silver Dyke Adit (07-135-SS-1).
- SW1 - Above Snow Creek confluence in Carpenter Creek.
- SW3 - Same as sample SE3.
- SW4 - Same as sample SE4.
- SW5 - Same as sample SE5.

DATE: November 15, 1990

CLIENT: **Abandoned Mines**

FIELD ID: Carpenter Creek Tailings

LAB NO: W8769

DATE RECEIVED: 10/08/90

Hardness 39 mg/L as $CaCO_3$

Total Metals

As	<0.1	mg/L
Cd	<0.005	mg/L
Cu	0.02	mg/L
Fe	<0.03	mg/L
Pb	<0.07	mg/L
Zn	0.84	mg/L

Reference No. 12

CULTURAL RESOURCE INVENTORY AND ASSESSMENT

of the

Neihart Mining District

Prepared for

L. C. Hanson Company
2969 Airport Road
Helena, MT 59601-1268

Under contract with

Montana Department of State Lands
1625 - 11th Avenue
Helena, MT 59620

By

Barbara Sommer
GCM Services, Inc.
P.O. Box 3047
Butte, MT 59702

June 1991

Site: Carpenter Creek Tailings (24CA315)

Description: This site contains two large diked tailings basins and five log structures. It is located on the south bank of Carpenter Creek between the drainages of Lucy Creek on the south and Haystack and Mackay Creeks on the north (Figures 8-11).

Historic Information: The tailings ponds are located in the vicinity of several early claims along Carpenter Creek. These include the Amathyst Lode, located on January 12, 1886 by Charles Crawford et.al., the Boneto and Roger Lodes, located on January 3, 1892 by William Jennings et. al., the Crusader, "88," Snow Creek Valley and Crusader #2 lodes, located in 1888 and 1891 by the Snow Creek Mining and Townsite Company, and the Silver Knight Templar and Valentine lodes, located in 1892 by the Snow Creek Mining and Townsite Company. The claims were patented during the years 1892-1894.

Mining activity in the Neihart district slowed considerably as a result of the Panic of 1893 and little work was done on many sites. No information on mine development or production records were found for these mines.

The tailings basins on the site were the ponds for the Silver Dyke mine, located to the south along Pioneer Ridge. They were included on a 1935 map of mining activity in the Neihart mining district. The buildings on the site are all that remain of a temporary camp set up as part of the Silver Dyke operation for about 100 men in 1922. These included a cook house and a dining room built of logs. An 1800 foot tramway, which has been removed, connected the site with the mine at the top of the hill.

Integrity: The site contains two large tailings ponds and five log or lumber buildings. The ponds were developed ca. 1923 to hold tailings from the Silver Dyke operation. The buildings are all that remain of a temporary support camp built as part of the Silver Dyke operation in 1922. Little evidence currently remains of the central or core part of the Silver Dyke operation. The buildings on this site are part of a complex which has been destroyed, leading to loss of physical integrity, since the context within which they were developed no longer exists. It is difficult at this time to identify how the site would have functioned or operated in relation to the overall Silver Dyke operation. In addition, the buildings and the tailings ponds are not associated with persons or events which would give them significance on their own, nor do they have interpretive value on their own. The later development of the tailings ponds on the site of the temporary camp has also destroyed the integrity of setting of the camp.

National Register Statement: The site is not recommended as eligible for listing on the National Register of Historic Places. Although it contains parts of mine sites which were patented from 1892-1894, no remains of the development from this period are currently found. It is not possible to determine how the sites functioned or were operated at the time they were patented. Development on the site at this time consists of two large tailings ponds and five buildings dating from development of the Silver Dyke operation. Neither integrity of setting or physical integrity have been retained.

Recommendations: The site has been recorded, mapped and photographed. No further work is recommended.

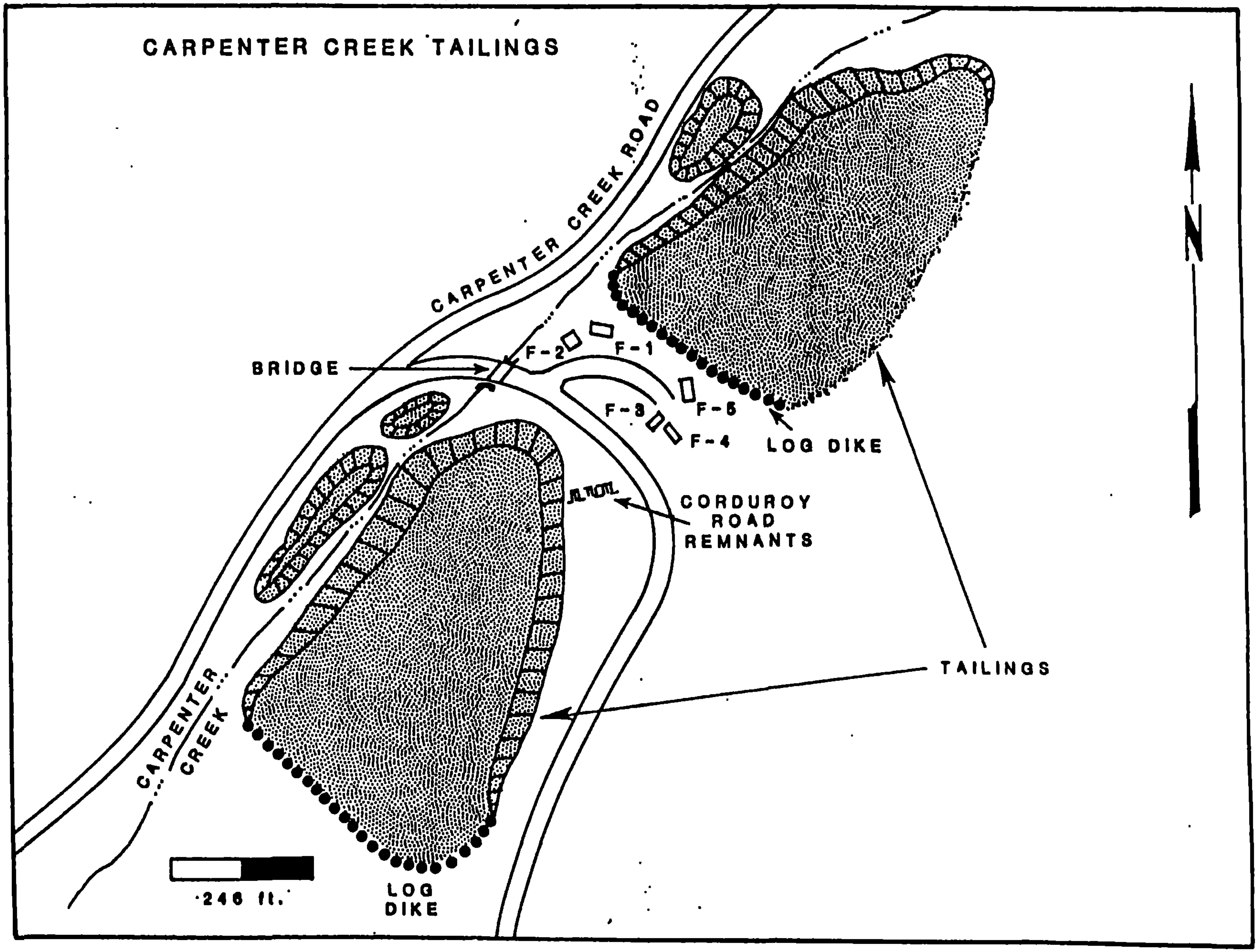


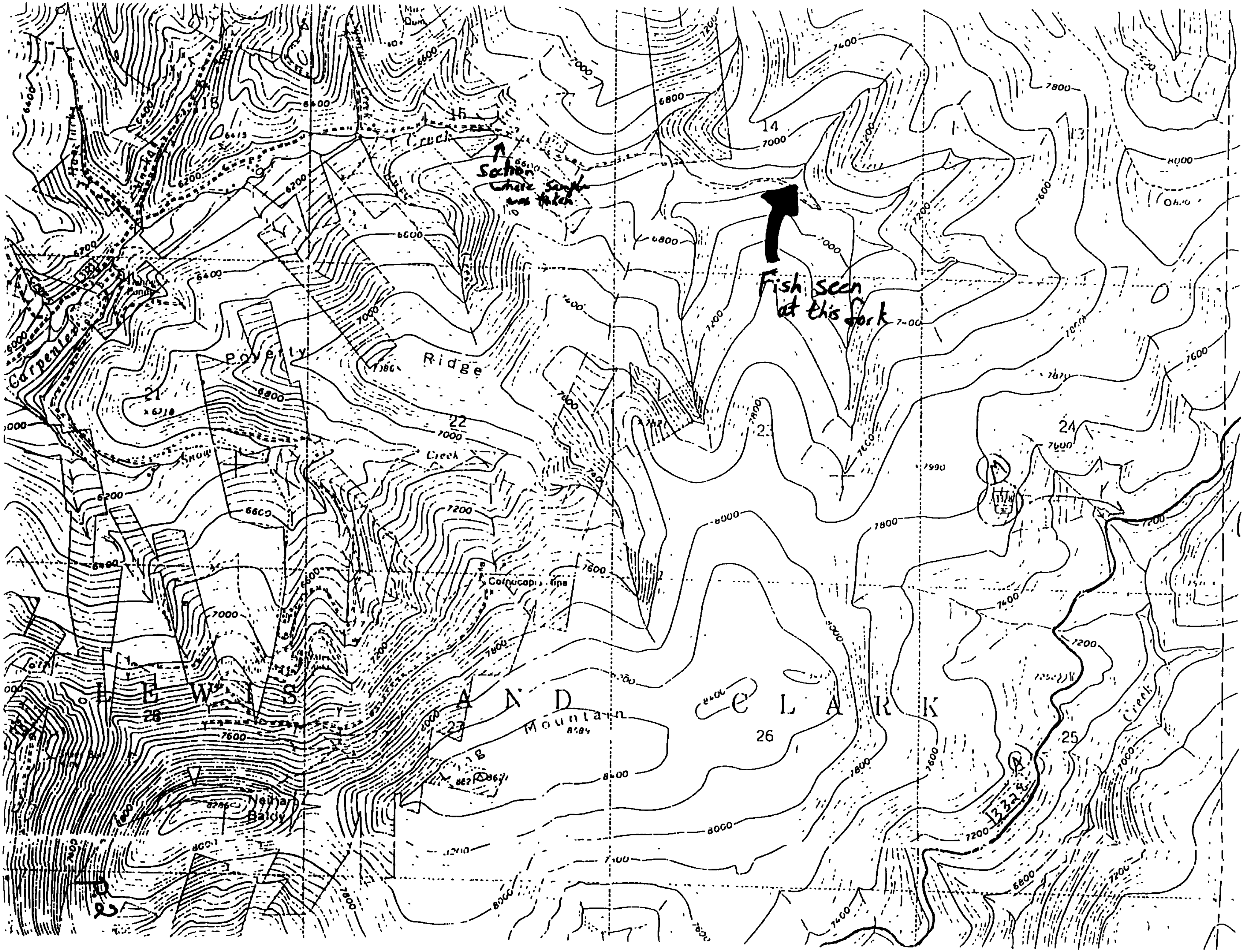
Figure 8. Map of Carpenter Creek Tailings (24CA315).

Reference No. 13

MEMORANDUM TO FILE

Date:	12/08/99
Time:	1100 hours
By:	Bryan Williams TTEMI
Subject:	Fisheries in the Carpenter/Snow Creek basin

Text: I spoke with George Liknes, Fisheries Biologist with Montana Fish, Wildlife, and Parks in Great Falls. Mr. Liknes said that an aboriginal population of native West Slope Cutthroat trout exists above the 1st tributary above Squaw Creek on Carpenter Creek, in section 15 of the topo map. He further stated that there was no reason the westies wouldn't have populated the entire Carpenter/Snow Creek drainage, save for mining activities. In addition, the State of Montana has a Catch & Release policy regarding the West Slope in effect since '98, and recognizes the area above Squaw Creek as a viable West Slope population. Mr. Liknes said "The original endemic salmonid population in the Belt Creek drainage would have been West Slope Cutthroat trout".


Section where sample was taken
Fish seen at this fork
Poverty Ridge
Snow Creek
Cornucopia Mine
Carpenter Creek
Neihart Baldy
Mountain
LEWIS AND CLARK
Creek
21
22
23
24
25
26
27
28
13
14
15
16

Fish Sampling Information

Water Name: Carpenter Cr. Date: 7/28/99 Legal: T 13N R 8E S SE15 Page 1 of 1
Section: Started below the polluted tributary from the north.
Observer(s): Whitaker/VanSickle Agency: LCNF

-Physical description of section-

Length: 140 meters Width: 2 meters Estimated flow: Above base flow Water Clarity: Clear
Temperature (water): 52°F (air): 79°F Time: 9:20 TDS: 30 ppm
Sampling gear: S/R 12A Settings: H-3 200 v. Comments:

-Fish information-

Survey type: Disease/Genetics Mark used: None Tag used: None Trip number: N/A
Measurement units: mm Sampling times: 9:40-10:00

	Sp.	L	W	Comments	Sp.	L	W	Comments
1	WCT	195						
2	WCT	188						
3	WCT	185						
4	WCT	185						
5	WCT	185						
6	WCT	183						
7	WCT	180						
8	WCT	178						
9	WCT	174						
10	WCT	172						
11	WCT	170						
12	WCT	170						
13	WCT	170						
14	WCT	168						
15	WCT	165						
16	WCT	144						
17	WCT	142						
18	WCT	140						
19	WCT	140						
20	WCT	138						
21	WCT	135						
22	WCT	135						
23	WCT	134						
24	WCT	132						
25	WCT	132						
26	WCT	130						
27	WCT	130						
28	WCT	130						
29	WCT	127						
30	WCT	120						

Comments: These 30 fish were used for disease testing. Extensive logging in the area. Some fish caught below unnamed, mining trib. at the lower end of the population. Access road now fixed, and it is possible to drive to upper reaches of stream. Fish are present at an upper fork (map attached).

FISH SAMPLING INFORMATION

Water Name: Carpenter Cr. Date: 6/19/97 Legal: T 14N R 8E S SW¼ 14 Page 1 of 1
Section: Upstream of the mine claim in sec 14 Observer(s): VANSICKLE, BAILY
Agency: USFS / LCNF

-Physical description of section-

Length: 420 m (paced) (units) Width: 2-3 m (units) Estimated flow: N/A cfs Water clarity: Clear
Temperature (water): 42° F/C (air): 61° F/C Time: 10:40 Conductivity: N/A uohms/cm
Sampling Gear: SR 12/A Settings: H-3 300v Comments:

Fish information - Estimate Type: Genetic Sample Mark used: N/A Tag used: N/A
Measurement units: mm Trip type: — Trip number: — Sampling Times: 9:30-10:40

	Sp.	L	W	Comments	Sp.	L	W	Comments
1	WCT	180						
2		170						
3		160						
4		150						
5		169		* Ripe Male				
6		141		* Ripe Male				
7		115		*				
8		128		*				
9		110		*				
10		119		*				
11								
12								
13								
14								
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16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

omments: * Marks Fish taken for genetics; Other fish were seen but not netted

FISH SAMPLING INFORMATION

Water Name: CARPENTER CR Date: 6/23/97 Legal: T14N R82 S SW 14 Page 1 of 1
Section: ROAD WASHOUT → UPSTREAM (50m) Observer(s): DOWNING / VAN SICKLE / COX / SM
Agency: USFS / LCNF

-Physical description of section-

Length: 50 meters (units) Width: 2.5 meters (units) Estimated flow: N/A cfs Water clarity: clear
Temperature (water): 48 F/C (air): 71 F/C Time: 1445 Conductivity: N/A uohms/cm
Sampling Gear: S/R - 12A Settings: A-3, 300 volts Comments:

Fish information - Estimate Type: Genetic Sample Mark used: none Tag used: NONE
Measurement units: mm Trip type: — Trip number: — Sampling Times: 1445 - 1515

	Sp.	L	W	Comments	Sp	L	W	Comments
1	WCT	142						
2	WCT	141						
3	WCT	141		Genetic Samples to				
4	WCT	131		be added to 6/19/97				
5	WCT	130		collection.				
6	WCT	122						
7								
8								
9								
10								
11								
12								
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25								
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27								
28								
29								
30								

Comments: STARTED SHOCKING WHERE SMALL TRIBUTARY FROM NORTH WASHED OUT ROAD

p4

FISH SAMPLING INFORMATION

Water Name: CARPENTER CR Section: FROM HIGHWAY BRIDGE → UPSTREAM Legal: T14N R08E Sec30NE

Date: 8 22 96 (mon day yr) Collection code: ______ Observer(s): DOWNING /VAN SICKLE

Agency: USFS /LCNF

Physical description of section -

Length: 150 METERS (units) Width: 25 METERS (units) Estimated flow: ____ cfs Sampling Gear: S/R -12A

Settings: H-3 / 200-300 VOLTS

Temperature (water): 55° F/C (air): 79° F/C Time: 1530 Water clarity: CLEAR

Conductivity/TDS: 90 uohms/cm ppm Comments: NO FISH CAUGHT OR SEEN DESPITE GOOD HABITAT

Fish information - Estimate Type: INITIAL SURVEY Mark Used: NONE Tag Used: NONE (Recaps circled)

Measurement units: MM Trip Type: — Trip Number: — Sampling Times: 1530 -1600

	Sp.	L	W	Comments	Sp.	L	W	Comments
1								
2	NO FISH CAUGHT OR SEEN							
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Comments: CONCRETE PAD UNDER HIGHWAY 89 BRIDGE MAY SERVE AS MIGRATION BARRIER AS WATER IS ONLY 1-2" DEEP.

Pg 1 of 1

FISH SAMPLING INFORMATION

Water Name: CARPENTER CR   Section: END OF ROAD UPSTREAM (3.6 MILES) FROM HIGHWAY 29   Legal: T14N R08E Sec 15 SE

Date: 8 22 96 (mon day yr)   Collection code: ______   Observer(s): VAN SICKLE / DOWNING

Agency: USFS / DOWNING

Physical description of section -

Length: 150 METERS (units)   Width: 1.5 METERS (units)   Estimated flow: ____ cfs   Sampling Gear: S/R - 12 A   Settings: H-3 @ 200-300 vs

Temperature (water): 48° F/C (air): 68° F/C   Time: 1330   Water clarity: CLEAR

Conductivity/TDS: 40 umhos/cm ppm   Comments: ______

Fish information - Estimate Type: INITIAL SURVEY   Mark Used: None   Tag Used: None (Recaps circled)

Measurement units: MM   Trip Type: —   Trip Number: —   Sampling Times: 1330 - 1430

	Sp.	L	W	Comments	Sp.	L	W	Comments
1	WCT	195						
2	"	185						
3	"	180						
4	"	180						
5	"	170						
6	"	170						
7	"	170						
8	"	165						
9	"	160						
10	"	150						
11	"	125						
12	"	125						
13	"	120						
14	"	120						
15	"	120						
16	"	115						
17	"	115						
18	"	110						
19	"	110						
20	"	105						
21	"	100						
22	"	95						
23	"	90						
24	"	85						
25								

Comments: POTENTIAL BARRIER DOWNSTREAM FISH USING ALMOST ALL AVAILABLE HABITAT, GOOD COVER AND POCKET WATER AVAILABLE

-POTENTIAL BARRIER IS 1.5 MILES FROM HIGHWAY 29. ; END OF CRUISABLE ROAD IS 3.6 MILES FROM HIGHWAY 29.

P.6

FISH SAMPLING INFORMATION

Water Name: Snow Cr. Section: Legal: T14N R 03E sec 21 SE

Date: 8 26 96 (mon day yr) Collection code: Observer(s): Downing/Van Sickle

Agency: USFS - LCNF

Physical description of section:

Length: 100 meters (units) Width: 1.5 meters (units) Estimated flow: cfs Sampling Gear: SR 12-A

Settings: H-3 300 v.

Temperature (water): 48° F/C (air): 84° F/C Time: 1120 Water clarity: Clear

Conductivity/TDS: 70 uohms/cm ppm Comments: NO FISH

Fish information - Estimate Type: Spot Survey Mark Used: None Tag Used: None (Recaps circled)

Measurement units: — Trip Type: — Trip Number: — Sampling Times: 1120-1140

	Sp.	L	W	Comments	Sp.	L	W	Comments
1								
2								
3				No Fish				
4				Shocked				
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Comments: Habitat abundant.
Man made log/drop barrier, photos taken
Heavy mining activity in this drainage. Potential chemical barrier from downstream tailings ponds.

Plate 4 Sample sites used to determine daily metals loading

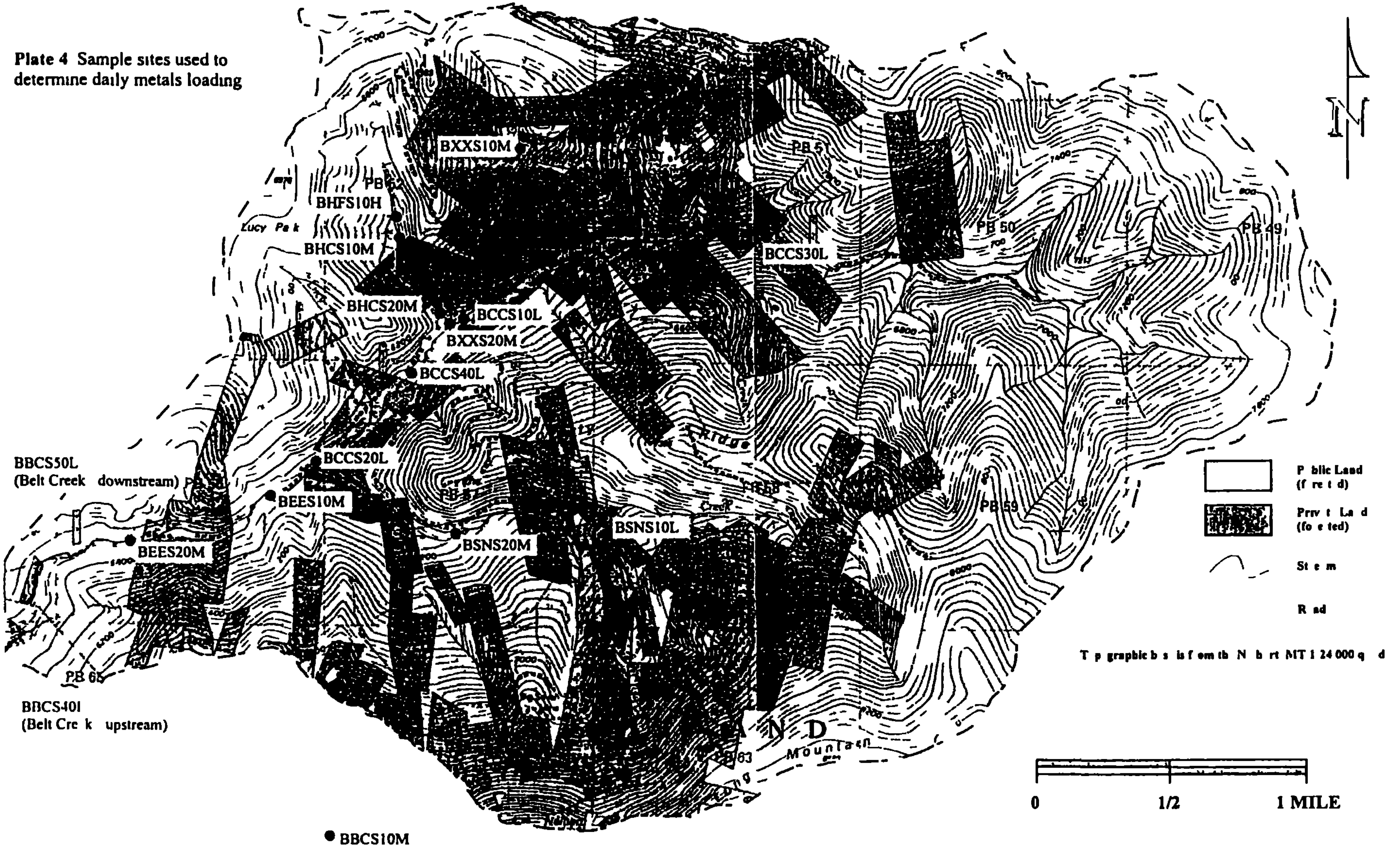
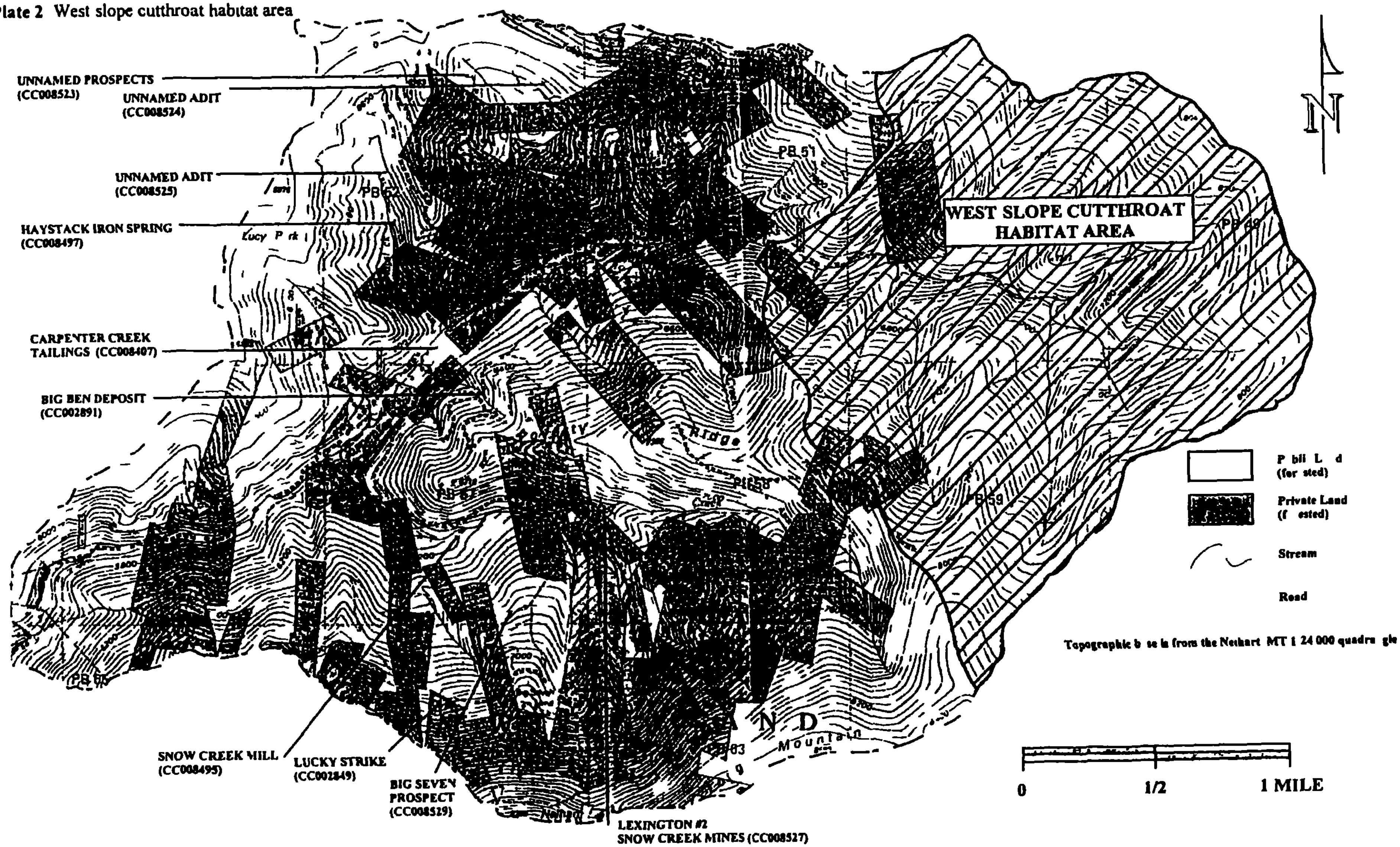


Plate 2 West slope cutthroat habitat area



Reference No. 15

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#450

ECONOMY FIELD BOOK

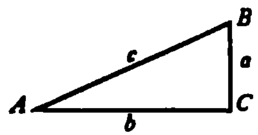
Carpenter + Snow Creek
HRS
TDD# 9909-0004

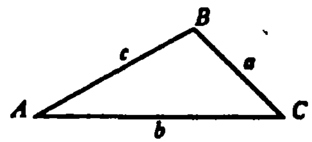
START

No. 8152-10

~~1 00000~~

FORMULAE FOR SOLVING RIGHT TRIANGLES





$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$

$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$

$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = c \sin A, b = c \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, c = \frac{b}{\cos A}.$
A, a	B, b, c	$B = 90° - A, b = a \cot A, c = \frac{a}{\sin A}.$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B, c = \sqrt{a^2 + b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, c = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

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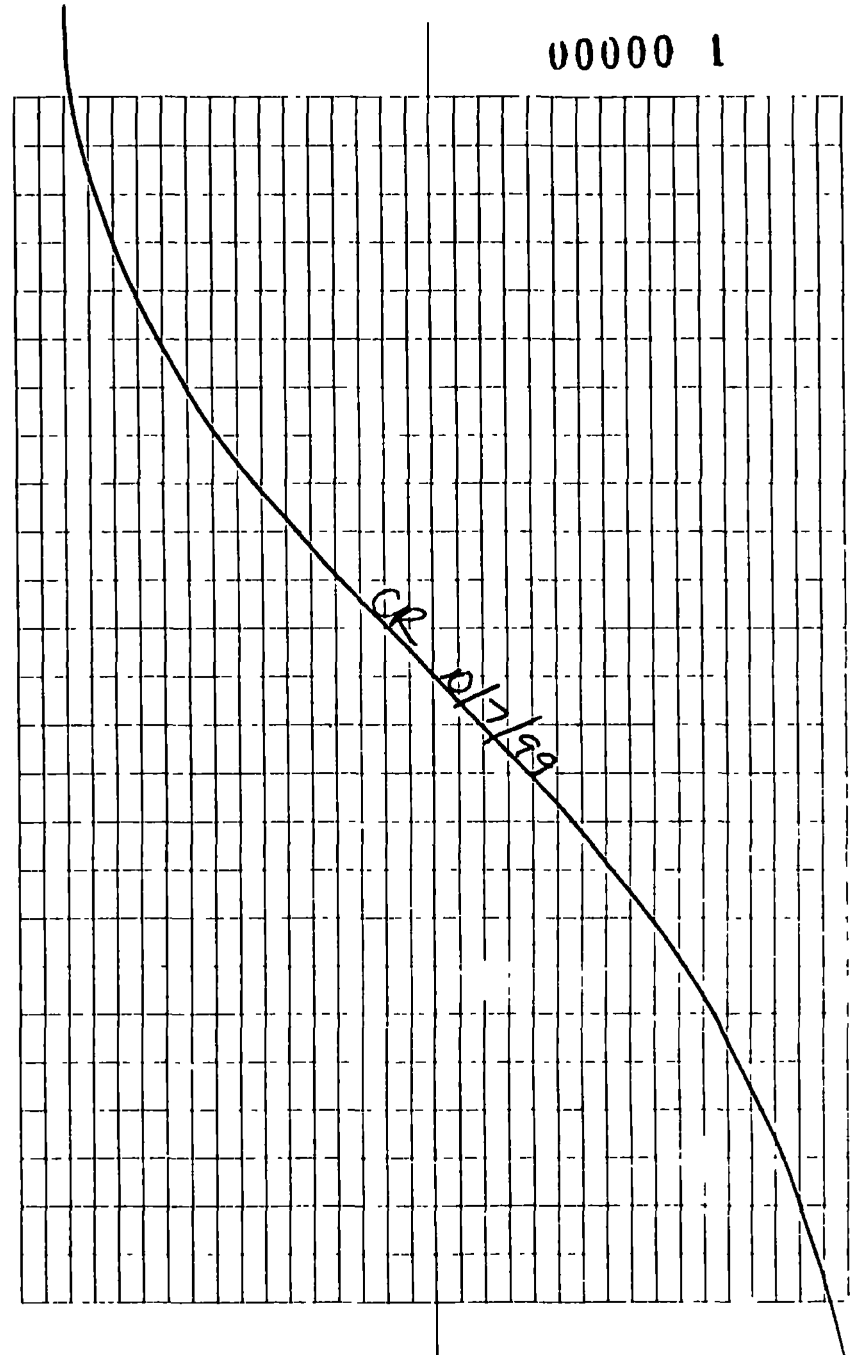


10/7/99 0000002 Crystal Roberts

10/7/99 CR

1330 arrived in Niehart, Dave Williams, Bryan Williams, Crystal Roberts, Judy
- several tailings piles in town just to the north
- turned east onto Carpenter Creek Rd water is clear with slightly orange color, fast running
- continued to drive northeast to Silver Dike Mine
- lot of logging in area
- turned up to look at Baker + Vilipa Mine Site, tailings pile (huge) washing down over road into Carpenter Creek. Judy stated that there is adit assoc with this mine site but doesn't know where it is, possibly on top.
- drove back down to Carpenter Creek Tailings pile, flat pile with creek running through it

CR 10/7/99

10/7/99 0000003 CR

- turned down Snow Creek Mill Rd
- wetlands identified east + west of road, area of wetlands to west of road is directly next to Carpenter Creek tailings pile

CR 10-7-99

- drove past Snow Creek Mill
- Saw mill sites from across valley Big Seven Mines, Rebellion Mines Ripple + Lexington Mines
- yellow house on Baker Mine Site Rd.
- motorcycle tracks on top of Carpenter Creek Tailings Site
- year round resident just south of Carpenter Creek Tailings Site on Carpenter Creek Rd.

CR 10-7-99

1600 left Carpenter Creek Rd
- drove through Niehart, tailings piles in town next to residences
- drove to old mine shaft directly east of town of Niehart, present is a seep on side of hill, very rust colored

CR 10.7.99

10/7/99 000004 CR

- spoke to clerk at grocery store who said that Belt Creek is full of Brown Trout "pan size" the other man in store (possibly owner of grocery store) said that he had never heard of people fishing in Carpenter Creek - too small.

CR 10/7/99

10/7/99 000005 CR

1630 left Niehart to drive back to Helena.

10/7/99 CR

Memorandum

To. The File

CC·

From Tom Mostad

Date 09/07/00

Re. Snow Creek Plume 6/9/00

At approximately 11 45 AM Friday June 6th, 2000, I received a phone call from Ron Mammen a resident of the Carpenter Creek area near Neihart, MT He stated that a large amount of brown water was coming from Snow Creek, a tributary of Carpenter Creek, which is a tributary of Belt Creek, and that the creek had risen 3 feet in about 5 minutes Mammen was concerned that if the flow rises any further, bridges could be washed out

Judy Reese, Ben Quinones, Tal Williams (pilot) and I, flew to the site of the reported problem We arrived on the site at approximately 2 20 PM and circled Belt Creek, Carpenter Creek and Snow Creek to determine the source of the problem The source was identified as the Lower Rebellion Mine Adit at approximately 2 40 PM I estimated the current discharge at 50 to 100 gallons per minute of opaque brown colored water exiting the adit There was a brown streak on the side of a mine building next to the adit, showed the initial flow was 4 to 5 feet higher than current flow Timbers and other debris piled up by the mine building as the flow spilled out the adit The waste dump in front of the adit had a ~10 foot erosion rill cut in it as the flow as it surged over the dump

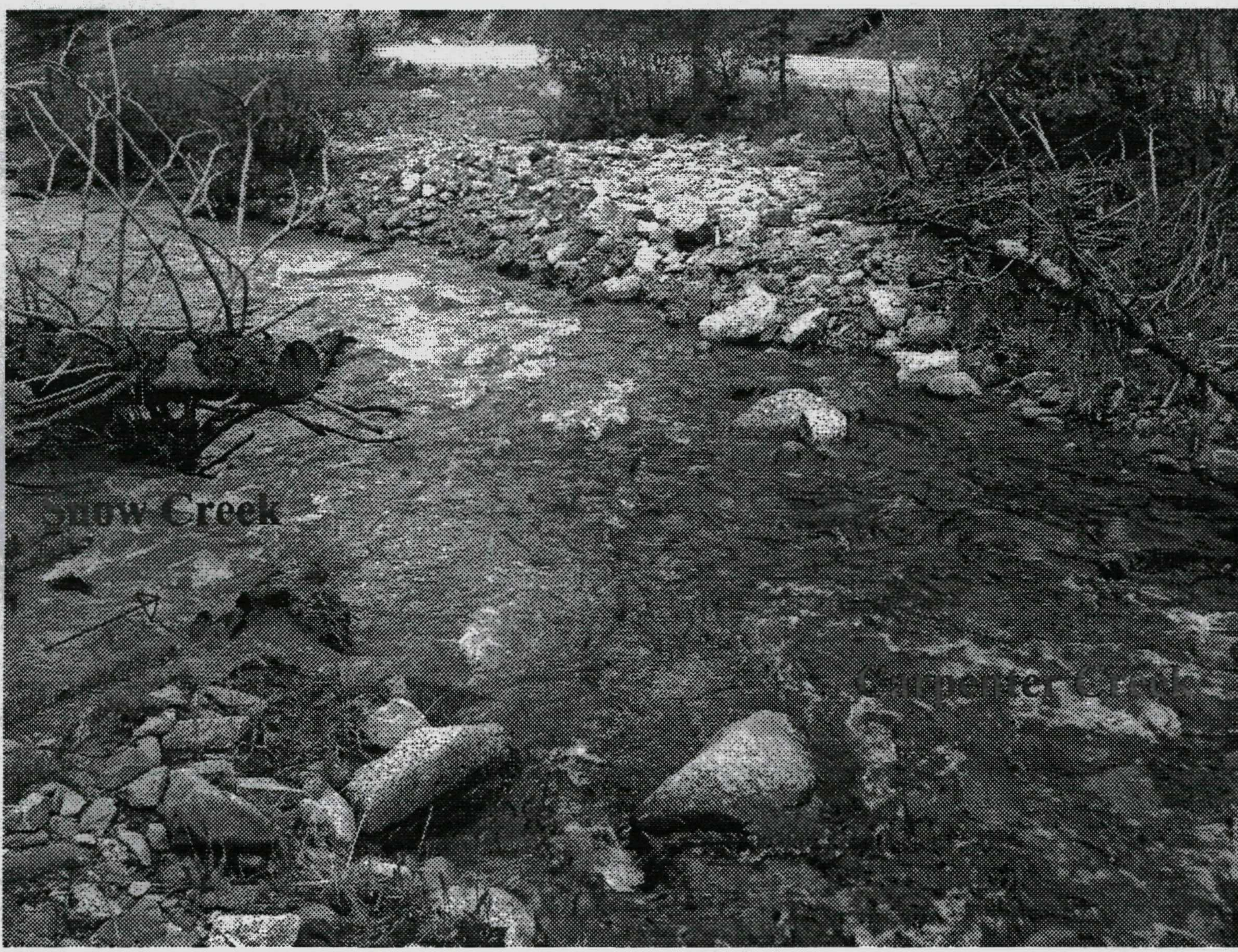
We then followed the plume down Carpenter Creek to Belt Creek and then down Belt Creek to the Forest Service Information Station on Belt Creek We dropped Ben and Judy off at there to contact Vic Andersen, and to take a sample of the Belt Creek The plume was just passing the Information Station which approximately eight miles from the adit

Tal flew me back up to the site where I photographed the site and took a water sample just above the confluence of Snow Creek and Carpenter Creek at 3 10PM The color was becoming a bit clearer as the plume seemed to be receding We left for Helena about 3 45AM The water samples were sent to the laboratory today

I believe that the massive discharge of muddy water was caused by a blockage in the adit, which may have been the result of a cave-in inside the mine The backed-up water increased until the pressure of the water caused a rapid release of the water and other waste The water then eroded the waste rock dump in front of the adit and the mixture flowed down the creek The surge of muddy water lasted at least 31/2 hours


Eroded
Waste Rock
Flow
Lower Rebellion Adit


Lower
Rebellion
Adit
Flow


Snow Creek
Carpenter Creek


Belt Creek
Carpenter Creek

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU

HAZARDOUS MATERIALS INVENTORY
SITE INVESTIGATION LOG SHEET

Mine/Site Name: REBELLION (UPPER & LOWER) **PA#:** 07-157 & 07-158

Date: June 9, 1994 **Time:** 0826-1120

Field Team Leader: Tuesday, Pioneer

Sampling Personnel: Belanger, Clark, West; Pioneer

Visitors: Earl McCurley, MDSL/AMRB
Tim Pfahler, MDSL Helicopter Pilot

Weather/Seasonality Observations: Clear skies; sunny; cold; slight breeze; snowed the day before investigation.

Photographic Log (Film Roll and Photo No.'s/Video Tape Number): 07-157, #1: WR-1; #2: WR-2 and loadout facing south; #3: WR-2 and loadout facing north; #4: WR-3; #5: WR-4 facing south; #6: WR-4 facing north; #7: Seep at base of WR-4 and WR-5, AD-1 sample location; #8: Seep at base of WR-4 below old loadout, AD-2 sample location; #9: Downgradient flow of seep at base of WR-4 below old loadout; #10: Upper Rebellion and Ripple in background); #11: Overview of site. 07-158, #12: Adit #1 discharge; #13: Lower Rebellion and corresponding dump; #14: Upper and Lower Rebellion.
Video Tape No. 1

General Comments/Observations (not covered specifically in attached Inventory Forms): N/A

Other Hazardous Materials/Substances Present: N/A

General Comments on Potential Remedial Alternatives: Divert adit discharge away from waste dumps and possibly treat. Recontour and revegetate dumps.

I. BACKGROUND INFORMATION

This information is to be collected to the extent practical prior to conducting the Site Investigation. Data gaps shall be filled in during the investigation.

Mine/Site Name(s): REBELLION (UPPER & LOWER) **PA#:** 07-157 & 07-158

Legal Description: **T** 14N **;R** 8E **;Sec.** 27 **,** SW **1/4** NW **1/4** ____ **1/4**
T 14N **;R** 8E **;Sec.** 27 **,** NW **1/4** NW **1/4** ____ **1/4**

County: CASCADE **Mining District:** NEIHART

Latitude: N 46° 56' 53" **Longitude:** W 110° 42' 13"
Latitude: N 46° 57' 00" **Longitude:** W 110° 42' 00"

Primary Drainage Basin and Code: Belt Creek/10030105
Secondary Drainage Basin: Snow Creek

USGS Quadrangle map name(s): Neihart

Mine Type/Commodities: Hardrock/Gold, Silver, Lead, Zinc

Activity Status: Active ___ **,Inactive/Exploration** ___ **,Abandoned** X **.**

Ownership: Known Y X **N** ___ **; private/public?** Private
Owner, Agent, or Contact (Include address and phone when available)**:** Hatfield, Great Falls, MT.

Relationship to other mines/sites in the area/district: Northwest of the Ripple Mine (07-149) and Ripple No. 3 (07-163).

Regulatory Status (Activity by other agencies)? Hardrock permits? Past Reclamation Activities? N/A

General site features: Elevation 6800'-7200'**, Slope** 23° **,**
Aspect North

Land use: Mining ___ **, Recreational** X **, Residential** ___ **, Urban** ___ **, Agricultural** ___ **, Other(Specify)** ___

Area of disturbed/unvegetated lands? 5 **acre(s).**
Site Dimensions: 500 feet x 300 feet (Upper); 200 feet x 400 feet (Lower)

Predominant vegetation types: Douglas fir/Lodgepole pine forest

Access: roads - good (paved) ___ **,poor (maintained dirt road)** ___ **, 4wd** X **,trail** ___ **.**
Other logistical considerations (proximity to other sites). Located directly below the Ripple Mine. Locked gate on Snow Creek Road approximately 1/2 mile below the Lower Rebellion.

Well logs within 1 mile radius; (Attach MBMG Well Log Printout(s): There are no wells reported within a 1 mile radius.

General site geologic, hydrologic, and hydrogeologic settings (Also note presence of radioactive minerals). Site is underlain by pinto diorite and gneiss. Site lies well above Snow Creek. Water leaving the site would flow north to confluence with Snow Creek approximately 1/3 mile away. Snow Creek flows west to confluence with Carpenter Creek 1.5 miles away. Carpenter Creek flows west to Belt Creek.

Mining/milling history, ore type/tenor, host rock, gangue: No history available. Vein deposit in pinto diorite and Precambrian gneisses. Gangue is mainly crushed, altered host rock.

Mine Operation?

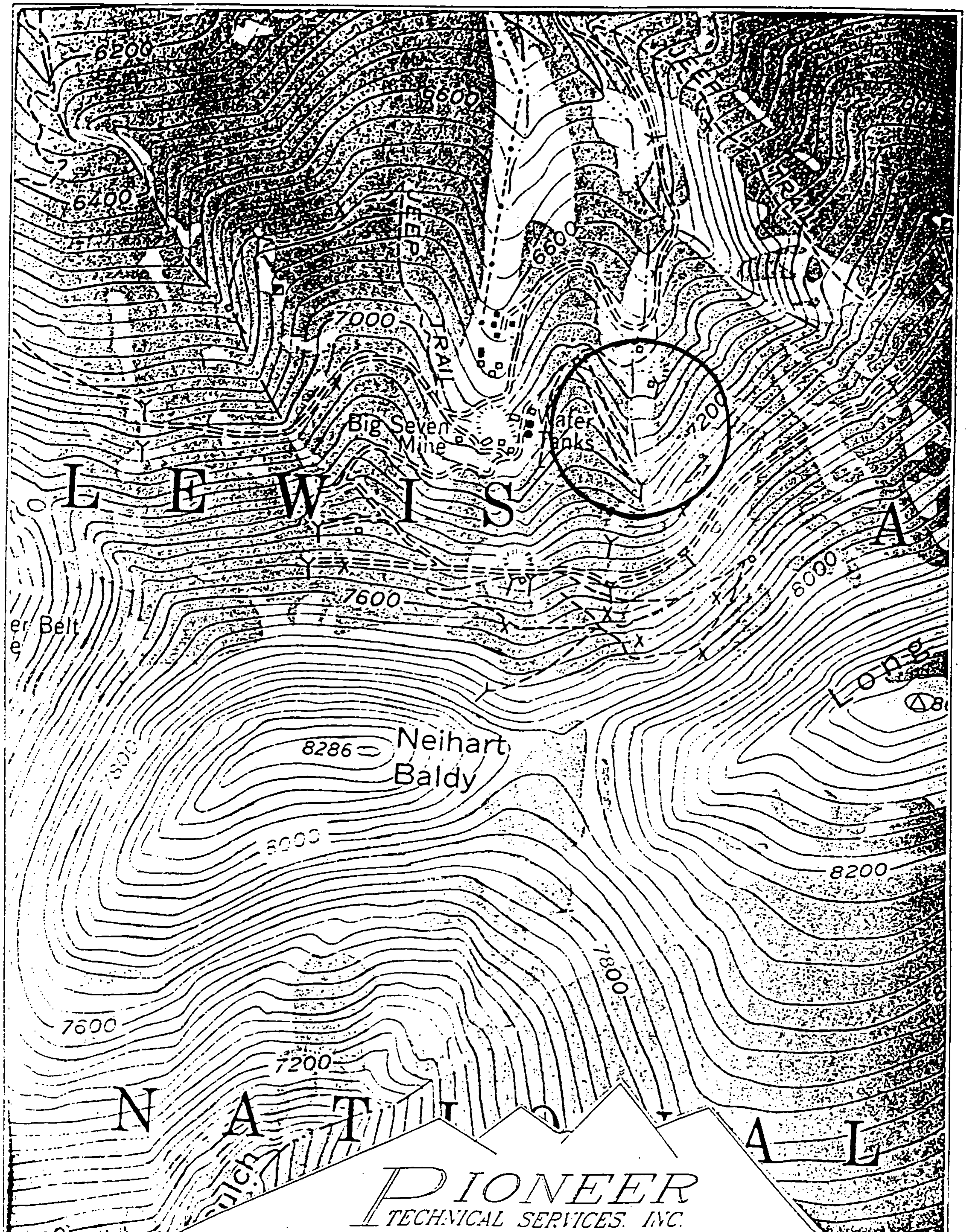
Shafts -	**Yes**___	**No** X	**#** ___	**Comment**
Adits -	**Yes** X	**No**___	**#** 3	**Comment** All caved; 2 discharging (Upper); 1 discharging (Lower)
Pits -	**Yes**___	**No** X	**#** ___	**Comment**
Placers -	**Yes**___	**No** X	**#** ___	**Comment**
Other -	**Yes**___	**No** X	**#** ___	**Comment**

Mill Operation? Yes____, **No** X. **If yes answer the next three questions:**

Period(s) of Operation: N/A

Origin of Ore Milled - Custom Mill___ **Dedicated Mill**___; **Number and names of mines that supplied mill feed:** N/A

Process? Hg-amalgam, CN⁻ leach (vat, heap), floatation, smelting?
N/A



REBELLION (UPPER & LOWER), P.A. NOS.
07-157 & 07-158
T14N, R08E, SECTION 27
SCALE: 1" = 1000'

II. INFORMATION COLLECTED ON SITE

A. SOLID MATRIX WASTE CHARACTERIZATION

1. **Waste Characteristics** - *Use table on following page.*

Unique source identification: (e.g. west waste rock dump #2) and abbreviation on sketch map and source list (e.g. WWRD2). Locate source on sketch map with any measured distances from at least two landmarks.

Source types: Waste rock dumps and piles (WR); tailings impoundments and piles (TAIL); vats, vessels, tanks that contain something (VAT); barrels - not empty (BAR); soils contaminated by spills or leaks (SP); suspected asbestos containing materials (ACM); garbage/refuse/junk dumps (DMP); other sources (OTH).

Source size: Estimated volumes (cu. yards or feet, # of barrels) for each source identified above.

Location/Description: List location and description for each source identified above.

Waste containment: Is the source contained with respect to groundwater, surface water, and airborne releases or the potential to release? Good, adequate, poor, or none. Are waste structures/vessels sound, are runon/runoff controls in place, are wastes covered or vegetated, pond liners intact?

2. TAILINGS IMPOUNDMENTS - *If tailings impoundments are also present, complete the following questions.*

Describe the tailings grain size distribution (approximate % sand, silt, & clay): N/A

Determine tailings impoundment depth and describe stratification of the tailings if observable (based on texture and color): N/A

Are tailings wet or dry (Describe location of partially wetted tailings impoundments): N/A

Describe condition of the tailings impoundment (Note condition of dams or structures, location of breaches): N/A

Comments on potential for mitigation: N/A

SOURCE INVENTORY FORM

SAMPLERS: Tuesday, Belanger

SOURCE I.D. NO.	SOURCE TYPE	SOURCE VOLUME (yd^3)	LOCATION/DESCRIPTION	CONTAIN-MENT	pH SU (D/S)*	RADIO-ACTIVITY (mR/HR)	LAB. SAMPLE NO.	DATE/TIME	ANALYSES
WR-1	WR	4,260	Upper Rebellion, east side of upper dump; west face, near middle	None	6.2 (D)	0.055	07-157-WR-1	06/09/94 1730	T-Metals, ABA
WR-2	WR	9,380	Upper Rebellion, west side of upper dump; south of loadout	None	6.6 (D)	0.075			
WR-3	WR	850	Upper Rebellion, center of middle pile	None	6.2 (D)	0.045			
WR-4A	WR	11,600	Upper Rebellion, east side of lower dump; above road	None	5.4 (D)	0.06	07-157-WR-2	06/09/94 1730	T-Metals, ABA
WR-4B	WR		Upper Rebellion, center of lower dump; below road	None	6.3 (D)	0.065			
WR-4C	WR		Upper Rebellion, southwest side of lower dump; above road	None	5.7 (D)	0.06			
WR-5	WR	1,160	Upper Rebellion, north end of lowest dump; near discharge	None	6.7 (D)	0.05			
WR-1A	WR	37,670	Lower Rebellion; west lobe	None	< 3.5 (D)	0.05	07-158-WR-1	06/09/94 1728	T-Metals, ABA
WR-1B	WR		Lower Rebellion; northwest lobe	None	3.9 (D)	0.05			
WR-1C	WR		Lower Rebellion; north lobe	None	5.2 (D)	0.05			
WR-1D	WR		Lower Rebellion; northeast lobe	None	6.0 (D)	0.07			

*D-Direct reading(Kelway Meter); S-Saturated Paste(Orion Meter)

Comments or deviations from SOPs: 07-157-WR-1 is composite of WR-1 through WR-3. 07-157-WR-2 is composite of WR-4A through -4C, and WR-5 (Upper Rebellion). 07-158-WR-1 is composite of WR-1A through -1D (Lower Rebellion). See Ripple Mine (07-163) for background soil sample.

B. GROUNDWATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map or topographic map.

Flowing adits: Yes X **, No** ___ **, Number:** 3 **Identification:** Adit associated with WR-5 and possible adit at the base of WR-4 (Upper); adit behind buildings (Lower).

Filled shafts: Yes ___ **, No** X **, Number:** ___ **Identification:** ___

Seeps/Springs: Yes ___ **, No** X **, Number:** ___ **Identification:** ___

Groundwater wells within 4 miles?: Yes X **, No** ___ **;**
Number of well logs: 7

Distance to nearest well used for drinking:
___ **<1,000 ft;** ___ **1,000 ft to 0.5 miles;** X **>0.5 miles.**

Sample types: Flowing adits (AD); filled shafts (SH); Residential wells (RW); Monitoring wells (MW); Seeps/Springs (SP).

Field Measurements: Flow (measured or estimated), pH (meter), Eh (meter), SC (meter), temperature (meter), Alkalinity (test kit)?

Potential for groundwater contamination (explain)?
Definite ___ **, Probable** ___ **, Possible** X **, Unlikely** ___ **.**
Uncontained waste rock containing elevated metals; groundwater i contact with adits and dumps.

Approximate Depth to Groundwater: X **<25 ft;** ___ **25 - 100 ft;** ___ **>100 ft.**

Other observations/notes: N/A

GROUNDWATER INVENTORY FORM

SAMPLERS: Tuesday, Belanger

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SOURCE	FLOW* cfs/gpm	pH SU	SC µS/cm @ 25°C	Eh mV	Temp °C	ALK. mg/L as $CaCO_3$	Depth ft	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
AD-1	AD	Upper Rebellion adit discharge at base of WR-4, near WR-5 (old adit)	20 gpm (E)	3.65	336	N/A	3.8	0	N/A	07-157-AD-1	06/09/94 1030	T-Metals, TDS, Hardness, Cl, SO4, NO2/NO3
AD-2	AD	Upper Rebellion adit discharge at base of WR-4 below old loadout (possible adit)	8 gpm (E)	3.57	289	N/A	2.8	0	N/A	07-157-AD-2	06/09/94 1040	T-Metals, TDS, Hardness, Cl, SO4, NO2/NO3
AD-1	AD	Lower Rebellion adit discharge from caved adit behind buildings	25 gpm (E)	6.14	139	N/A	3.0	0	N/A	07-158-AD-1	06/09/94 1200	T-Metals, TDS, Hardness, Cl, SO4, NO2/NO3
SW-2	SP	Seep from WR-1 at Lower Rebellion	1 gpm (E)	3.53	339	NM	4.7	NM	N/A	N/A	N/A	Field Parameters

*FLOW: Estimated (E) or Measured (M) from adit, shaft, seep or spring?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): NM = Not Measured

C. SURFACE WATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map or topographic map. Indicate drainage patterns (run-on/runoff) and directions on sketch maps.

Flowing streams: Yes X, No ___, **Name(s):** Unnamed tributary of Snow Creek

Dry streambeds: Yes ___, No X, **Name(s):** ___

Other surface water: Yes X, No ___, **Name(s)/Description:** Adit discharge, which flows down the drainage below the Lower Rebellion

Waste materials within any floodplain: Yes X, No ___ **Source ID(s):** WR-2, WR-4, and WR-5 (Upper); WR-1 (Lower)

Approximate Flood frequency? X 1 yr, ___ 10 yr, ___ 100 yr

Estimated seasonal flow of stream(s) (cfs/gpm)? 20 gpm
High Flow: 50 gpm, **Average Flow:** Dry

Distance between waste source(s) and nearest surface water body (ft)? 0 feet

Surface water draining onto or through waste sources: Yes X, No ___,
Describe: Adit discharges flow through the waste piles.

Surface water use within 15 miles downstream? (Drinking water supply, irrigation, residential use? Sensitive environments within 15 miles downstream? Park, Wilderness, Fishery, Wetland, T&E habitat?)
Belt Creek has fishery, recreation, and agriculture.

Observed erosional/sedimentation/stream turbidity problems? Yes X, No ___. **Distance downstream (ft)?** 0-500 X; 500-1,000 ___; >1,000 ___.
Describe/explain (Note streambank stability and condition of streambank vegetation and any manmade structures or channel changes present): At the Lower Rebellion, water stopped flowing approximately 200 feet below the toe of WR-1. Waste rock material lies within the stream channel.

SURFACE WATER INVENTORY FORM

SAMPLERS: ____________________

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SAMPLE LOCATION	pH SU	SC µS/cm @ 25°C	Temp °C	ALK. mg/L as $CaCO_3$	Flow* cfs/gpm	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
SW-1	SW	Downstream from Lower Rebellion in unnamed tributary of Snow Creek	4.65	141	3.7	0	12 gpm (E)	07-158-SW-1	06/09/94 1245	T-Metals, TDS, Hardness, Cl, SO4, NO2/NO3

*FLOW: Estimated (E) or Measured (M)?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): ____________________

D. ACID MINE DRAINAGE (AMD) POTENTIAL

Evaluate each source in table on next page.

AMD Characteristics:

Presence and abundance of sulfides? (SO3)

Presence of evaporative salt deposits? (ESD)

Discolored or turbid seepage? (SPG)

Presence of long filamentous algae in drainages, mosses in moist areas?

Presence of ferric hydroxide precipitates? (FEOX)

Presence of burned or stressed vegetation? (VEG)

pH ≤ 5.0 (pH)

General Potential for AMD Mitigation:

Area available for treatment (acres)? Approximately 2.5 acres with some tree removal; otherwise, 1 to 1.5 acres.

Wetlands present: Yes X , No ____, Describe: At the Lower Rebellion, small wetlands are present 50 feet below WR-1.

Carbonate rocks/soils: Yes ___, No X , Describe:

E. AIR PATHWAY CHARACTERISTICS

Population within 4-mile radius: 1-10___; 10-30___; 30-100 X ; 100-300____; 300-1,000____; 1,000-3,000____; 3,000-10,000____; 10,000 or greater___; Comments

Nearest residence: ___<1,000 ft; ___1,000 ft - 0.5 miles; X >0.5 miles.

For each source (table next page):

Available fine materials? Surface area?

Uncovered and unvegetated? Wet or dry?

Overall dust propagation potential:
observed high moderate low none

ACID DRAINAGE/AIR PATHWAY INVENTORY FORM

SAMPLERS: Tuesday, Belanger

SOURCE I.D. NO.	ACID MINE DRAINAGE CHARACTERISTICS (LIST)	MOISTURE CONTENT (WET/DRY/PARTIAL)	SURFACE AREA (SQUARE FEET)	UNCOVERED/UNVEGETATED AREA (SQUARE FEET)	AVAILABLE FINES (YES/NO)	DUST PROPAGATION POTENTIAL (OBSERVED/HIGH/MODERATE/LOW/NONE)
UPPER WR-1	SO3	Dry	19,160	19,160	Yes	Low
WR-2	SO3; FEOX	Dry	42,220	42,220	Yes	Low
WR-3	FEOX	Dry	4,610	4,610	Yes	Low
WR-4	SO3; FEOX	Dry	52,180	52,180	Yes	Low
WR-5	FEOX	Dry	5,230	4,970	No	Low
AD-1	pH; FEOX	N/A	N/A	N/A	N/A	N/A
AD-2	pH; FEOX	N/A	N/A	N/A	N/A	N/A
LOWER WR-1	SO3; pH	Dry	67,810	61,030	Yes	Moderate
AD-1	FEOX	N/A	N/A	N/A	N/A	N/A

Notes and Clarifications:

F. DIRECT CONTACT CHARACTERISTICS

Residents or workers within 200 feet of sources: Yes____, No_X_
Describe:__________

Population within 1 mile: 1-10_X_; 10-30___; 30-100___; 100-300___; 300-1,000___; 1,000-3,000___; 3,000-10,000___; 10,000 or greater___;
Comments__________

Evidence of recreational use on site: Yes___, No_X_, Describe:________

Accessibility (check each that apply):___Easily accessible - no fences, gates, or warning signs;___Moderately Accessible - barbed wire fences, road gated, or signs posted;_X_Difficult Access - chain-link fence, road gated and locked, site guarded (does not include locked or manned access points located more than 0.5 miles from the actual site).

Sensitive environments on-site or adjacent to site:

State or National Parks -	**Yes___,**	**No_X_,**	**Comment**________
Wilderness Area -	**Yes___,**	**No_X_,**	**Comment**________
T&E Species Habitat -	**Yes___,**	**No_X_,**	**Comment**________
Bat Habitat -	**Yes___,**	**No_X_,**	**Comment**________

Primary Drainage_X_; Secondary Drainage___; No Information___:
- **Riparian Habitat Quality - High___, Medium_X_, Low___**
- **Wetlands Frontage - High___, Medium___, Low_X_**
- **Fisheries Habitat and Species Classification - _4_**
- **Sport Fishery Classification - _3_**

G. SAFETY CHARACTERISTICS

Verify completeness of AMRB Inventory

Hazardous openings: Yes___, No_X_, Number____, types and locations:___

Hazardous structures: Yes_X_, No___, Number_4__, types and locations:_ Two loadouts located on WR-2 (Upper); two old sheds on top of dump (Lower)

Unstable highwalls, pits, trenches, slopes: Yes___, No_X_, Number____, types and locations:__________

Unstable waste piles, impoundments, undercut banks: Yes____, No_X_, Number____, types and locations:__________

Fire and/or Explosion hazards: Yes___, No_X_, Explain:__________

Bibliography

MBMG, Well Log Database, July 14, 1994.

MDFWP, Montana Rivers Information System Rivers Report, Version 2.0, Prepared by Montana Natural Resource Information System, December 1989.

MDSL/AMRB Files, Abandoned Mine Reclamation Inventory Field Forms for Upper and Lower Rebellion Mine, Prepared by Chen-Northern, October 23, 1989.

USGS, Topographic Map, Neihart, Montana, 7 1/2 minute Quadrangle, 1961.

AIMSS SCORESHEET

SITE NAME: Rebellion Upper & Lower
PA NUMBER: 07-157

LINE NO.				
		GROUNDWATER PATHWAY		
1	GW - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		0
2		EXCEEDENCES		0
3A		CONTAINMENT		20
3B		GW DEPTH		20
3C		POTENTIAL TO RELEASE	LINES 3A x 3B	400
4		LIKELIHOOD SCORE	LINES 1 + 2 + 3C	400
5	GW - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	70.355
6	GW - TARGETS	WELLS - 1 MI. x 2.5		0.0
7		WELLS - 1 TO 4 MI		7
8		NEAREST WELL		0
9		TARGETS SCORE	LINES 6 + 7 + 8	7.0
10		GROUNDWATER SCORE	LINES 4 x 5 x 9	196994
		SURFACE WATER PATHWAY		
11	SW - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		0
12		EXCEEDENCES		100
13A		CONTAINMENT		20
13B		DISTANCE TO SW		20
13C		POTENTIAL TO RELEASE	LINES 13A x 13B	400
14		LIKELIHOOD SCORE	LINES 11 + 12 + 13C	500
15	SW - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	78.833
16	SW - TARGETS	DRINKING WATER POP'N		0
17		IMPACTED DRAINAGE		0
18		WETLANDS		10
19		FISHERY		1
20		RECREATION		5
21		IRRIGATION/STOCK		2
22		T & E SPECIES HABITAT		0
23		TARGETS SCORE	SUM LINES 16 THRU 22	18
24		SURFACE WATER SCORE	LINES 14 x 15 x 23	709497
		AIR PATHWAY		
25	AIR - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		0
26A		CONTAINMENT		5
26B		DISTANCE TO POPULATION		5
26C		POTENTIAL TO RELEASE	LINES 26A x 26B	25
27		LIKELIHOOD SCORE	LINES 25 + 26C	25
28	AIR - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	0.702
29	AIR - TARGETS	POPULATION - 4 MILES		30
30		NEAREST RESIDENCE		0
31		WETLANDS		0
32		PARKS / WILDERNESS		0
33		T & E SPECIES HABITAT		0
34		TARGETS SCORE	SUM LINES 29 THRU 33	30
35		AIR PATHWAY SCORE	LINES 27 x 28 x 34	527
		DIRECT CONTACT PATHWAY		
36	LIKELIHOOD OF EXPOSURE	OBSERVED EXPOSURE		0
37A		ACCESSIBILITY		5
37B		DISTANCE TO POPULATION		5
37C		POTENTIAL EXPOSURE	LINES 37A x 37B	25
38		LIKELIHOOD SCORE	LINES 36 + 37C	25
39	D. C. WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	0.629
40	DIRECT CONTACT TARGETS	POPULATION - 1 MILE		1
41		NEAREST RESIDENCE		0
42		RECREATIONAL USE		0
43		TARGETS SCORE	SUM LINES 40 THRU 42	1
44		DIRECT CONTACT SCORE	LINES 38 x 39 x 43	16
45	TOTAL SITE HUMAN & ENVIRONMENTAL HAZARD SCORE (LINES 10 + 24 + 35 + 44) / 100,000			9.07

15

LINE NO.		SITE SAFETY	SITE NAME: PA NUMBER:	Rebellion Upper & Lower 07-157
1	THREAT	ACCESSIBILITY		5
2		OPEN SHAFTS	100 EA.	0
3		OPEN ADITS	50 EA.	0
4	HAZARDS	UNSTAB. HIWALLS / PITS	75 EA.	0
5		HAZ. STRUCTURES	40 EA.	160
6		EXPLOSIVES		0
7		HAZ. MATERIALS		0
8		HAZARDS SCORE	SUM LINES 2 THRU 7	160
9		POPULATION - 1 MILE		1
10	TARGETS	NEAREST RESIDENCE		0
11		RECREATIONAL USE		0
12		TARGETS SCORE	SUM LINES 9 THRU 11	1
13		SITE SAFETY SCORE	(LINES 1 x 8 x 12) / 1,000	0.80

ABANDONED AND INACTIVE MINES SCORING SYSTEM (AIMSS) SCORESHEET

REBELLION (UPPER & LOWER)
PA NO. 07-157 & 07-158

MDSL AMRB/PIONEER 5/16/94

LABORATORY ANALYTICAL DATA

REBELLION (UPPER & LOWER)
PA NO. 07-157 & 07-158

Rebellion (Upper & Lower) PA# 07-157 & 07-158
AMRB HAZARDOUS MATERIALS INVENTORY
INVESTIGATOR: PIONEER - TUESDAY
INVESTIGATION DATE: 06/09/94

SOLID MATRIX ANALYSES

Metals in soils
Results per dry weight basis

FIELD ID	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/Kg)
07-157-WR1	67.9 J	181	401	10.1 JX	6.37 J	4.86 J	64.0 J	22900	0.48	7090 J	7.6	2380 JX	9.4	2040	NR
07-157-WR2	98.7 J	155	345	12.8 JX	5.18 J	5.89 J	117 J	36300	0.34	1920 J	5.5	3090 JX	11.4	2950	NR
07-158-WR1 (4.5)	7.9 J	53.9	29.5	3.71 JX	10.8 J	8.92 J	71.4 J (58.5)	24000	0.42	1990 J	15.1 (495)	713 JX	4.7 UJ	536	NR
BACKGROUND	0.5	9.6	87.6	1.32 JX	9.05 J	27.2 J	10.8 J (13.2)	21100	0.04	708 J	10.3 (755)	52.4 JX	4.7 UJ	135	NR

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Acid/Base Accounting

FIELD ID	TOTAL SULFUR %	TOTAL SULFUR ACID BASE t/1000t	NEUTRAL. POTENT. t/1000t	SULFUR ACID BASE POTENT. t/1000t	SULFATE SULFUR %	PYRITIC SULFUR %	ORGANIC SULFUR %	PYRITIC SULFUR ACID BASE t/1000t	SULFUR ACID BASE POTENT. t/1000t
07-157-WR1	1.20	37.5	39.0	1.48	0.26	0.59	0.35	18.4	20.5
07-157-WR2	0.49	15.3	3.24	-12	0.34	0.02	0.13	0.62	2.62
07-158-WR1	0.52	16.2	3.71	-13	0.26	0.08	0.18	2.50	1.21

WATER MATRIX ANALYSES

Metals in Water
Results in ug/L

FIELD ID	Ag	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC. (mg CaCO3/L)
07-157-AD1	4.42	15.4	15.1	68.5	16.4	7.1 JX	263	6880	0.11 U	10200	45.5	221	29.4 U	10200	113
07-157-AD2	4.23	12.5	15.0	68.1	16.7	5.5 JX	263	5680	0.11 U	10300	40.8	235	29.4 U	10400	115
07-158-AD1	1.12	1.1 U	12.2	22.9	11.7	4.7 UX	45.6	1780	0.11 U	9140	29.8	53.5	29.4 U	4730	124
07-158-SW1	1.13	1.1 U	12.5	42.0	8.7 U	4.7 UX	97.2	25.0	0.11 U	7960	38.9	19.1	29.4 U	7450	116

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Wet Chemistry
Results in mg/l

FIELD I.D.	TOTAL DISSOLVED SOLIDS	CHLORIDE	SULFATE	NO3/NO2-N	CYANIDE
07-157-AD1	284	<5	166	<0.05	NR
07-157-AD2	271	<5	168	0.25	NR
07-158-AD1	233	<5	141	<0.05	NR
07-158-SW1	243	<5	142	<0.05	NR

LEGEND

07-157-WR1 - Composite of subsamples WR1 through WR3.
07-157-WR2 - Composite of subsamples WR4A through 4C and 5.
07-158-WR1 - Composite of subsamples WR1A through 1D.
BACKGROUND - From the Ripple Mine (07-163-051).
07-157-AD1 - Adit discharge at base of WR4, near WR5.
07-157-AD2 - Adit discharge at base of WR4 below old loadout.
07-158-AD1 - Adit discharge from the caved adit behind buildings at Lower R
07-158-SW1 - Downstream from Lower Rebellion mine in unnamed trib. of Snow Creek.

9

XRF ANALYSIS RESULTS

REBELLION (UPPER & LOWER)
PA NO. 07-157 & 07-158

MDSL AMRB/PIONEER 5/16/94

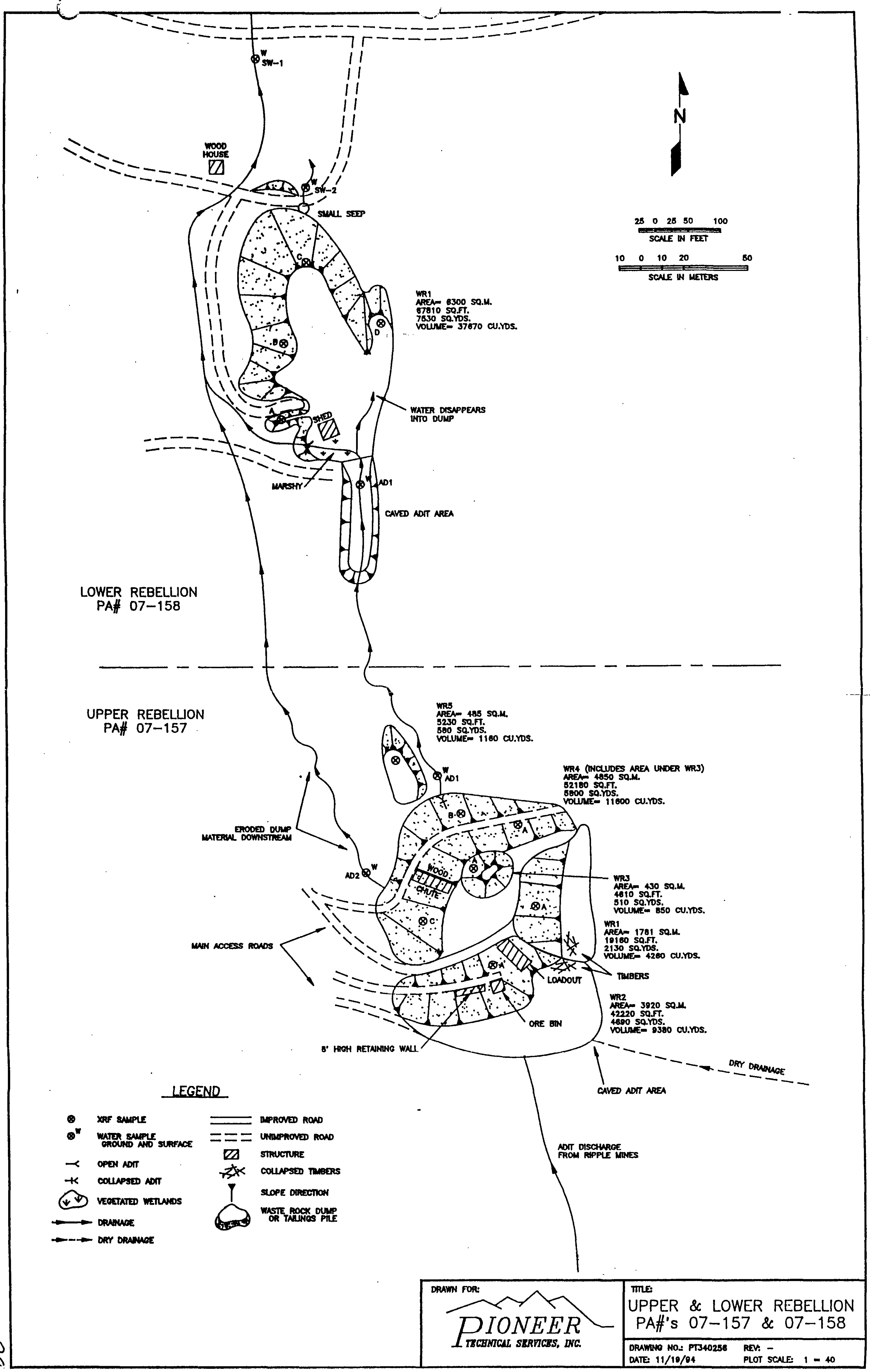
Mine Name: Rebellion (Upper & Lower) PA# 07-157 & 07-158
XRF Field Analyses
Results in PPM

XRF SAMPLE I.D.	CrHI	K	Ca	Ti	CrLO	Mn	Fe	Co	Ni	Cu	Zn	As	Sr
07-157-WR1		45053.7	7991.26	3182.3		10123.4	28129.7		179.168 *	138.965 *	3254.05		166.367
07-157-WR1-COMP		40348.9	8397.64	3928.43		4824.85	29423.1			132.374 *	1339.27		119.612
07-157-WR2		39584.5	2637.11	2679.96			34338.6			151.246 *	630.55		106.1
07-157-WR2-COMP		30048.5	3038.23	3204.8		4506.16	51196.6			165.064 *	1239.12		67.9393
07-157-WR3		51213.4	19338.9	3490.58		8487.45	22760.5		195.855 *		1075.22		106.441
07-157-WR4A		35852.6	1503.96	2648.55		806.512 *	53333.7			221.77 *	1431.24		27.2011 *
07-157-WR4B		34744	2676.3	3427.55		4990.38	52838.5		158.519 *	168.252 *	656.237		95.9003
07-157-WR4C		45559.5	5556.46	5089.75			39037.7			200.254 *	1781.24		113.448
07-157-WR5		32081.4	3200.02	3905.92		8004.25	62878.8			132.375 *	2189.44		82.3224
07-158-WR1A		20655.6	5401.48	3541.83		6724.33	81561.6			116.614 *	749.276		219.05
07-158-WR1B	300 $	19140 $	7470 $	4880 $		5970 $	46030 $		109 $	181 $	641 $	74 $	200 $
07-158-WR1C		36240 $	2190 $	2250 $		1910 $	60120 $	270 $		37 $	2039 $		67.5 $
07-158-WR1D		18020 $	1770 $	389 $	275 $	940 $	12860 $		56 $	22 $	418 $	31 $	68.2 $
07-158-WR1-COMP	220 $	21460 $	4700 $	3080 $		3560 $	53860 $		122 $	52 $	1534 $		181.7 $

XRF SAMPLE I.D.	Zr	Hg	Mo	Pb	Rb	Cd	Sn	Sb	Ba	Ag	U	Th
07-157-WR1	133.687			2809.63	271.273	169.596 *		68.7436 *	3938.11	227.766 *		
07-157-WR1-COMP	167.368			2617.55	216.442				1587.28	108.559 *		24.9926 *
07-157-WR2	268.506			3091.78	211.804				2030.55	130.415 *		25.0533 *
07-157-WR2-COMP	145.462		17.1071 *	3533.98	225.442				2325.24	218.327 *		31.1187 *
07-157-WR3	234.079			399.264	291.097				215.481		22.817 *	19.0695 *
07-157-WR4A	204.582		27.6898 *	5567.69	213.593				206.792	460.08		
07-157-WR4B	172.959			1763.84	223.164				484.959			
07-157-WR4C	305.803			4153.6	268.548	198.165 *		122.302 *	4553.81	154.728 *		39.8441 *
07-157-WR5	180.205			1455.73	226.376				450.639			
07-158-WR1A	498.002		16.7459 *	1836.68	153.888	220.027 *			996.921			
07-158-WR1B	171.7 $			123 $	142.8 $				746 $	153 $	23.9 $	15.6 $
07-158-WR1C	175 $		20.6 $	3370 $	243 $	134 $			311 $	73 $	8.3 $	
07-158-WR1D	123.4 $			216 $	187.9 $			15 $	359 $	65 $	19 $	21.8 $
07-158-WR1-COMP	213.4 $		9.7 $	1039 $	180 $	96 $			500 $	35 $	12.7 $	21.8 $

* = Estimated Quantity

$ = Unvalidated Data



W SW-1
WOOD HOUSE
W SW-2
SMALL SEEP
N
25 0 25 50 100
SCALE IN FEET
10 0 10 20 50
SCALE IN METERS
WR1
AREA= 6300 SQ.M.
67810 SQ.FT.
7530 SQ.YDS.
VOLUME= 37670 CU.YDS.
A
B
C
D
SHED
WATER DISAPPEARS INTO DUMP
MARSHY
W AD1
CAVED ADIT AREA
LOWER REBELLION
PA# 07-158
UPPER REBELLION
PA# 07-157
WR5
AREA= 485 SQ.M.
5230 SQ.FT.
580 SQ.YDS.
VOLUME= 1160 CU.YDS.
W AD1
WR4 (INCLUDES AREA UNDER WR3)
AREA= 4850 SQ.M.
52180 SQ.FT.
5800 SQ.YDS.
VOLUME= 11600 CU.YDS.
ERODED DUMP MATERIAL DOWNSTREAM
AD2 W
WOOD CHUTE
WR3
AREA= 430 SQ.M.
4610 SQ.FT.
510 SQ.YDS.
VOLUME= 850 CU.YDS.
WR1
AREA= 1781 SQ.M.
19160 SQ.FT.
2130 SQ.YDS.
VOLUME= 4260 CU.YDS.
MAIN ACCESS ROADS
TIMBERS
LOADOUT
WR2
AREA= 3920 SQ.M.
42220 SQ.FT.
4690 SQ.YDS.
VOLUME= 9380 CU.YDS.
ORE BIN
8' HIGH RETAINING WALL
DRY DRAINAGE
CAVED ADIT AREA
LEGEND
XRF SAMPLE
WATER SAMPLE GROUND AND SURFACE
OPEN ADIT
COLLAPSED ADIT
VEGETATED WETLANDS
DRAINAGE
DRY DRAINAGE
IMPROVED ROAD
UNIMPROVED ROAD
STRUCTURE
COLLAPSED TIMBERS
SLOPE DIRECTION
WASTE ROCK DUMP OR TAILINGS PILE
ADIT DISCHARGE FROM RIPPLE MINES
DRAWN FOR:
PIONEER
TECHNICAL SERVICES, INC.
TITLE:
UPPER & LOWER REBELLION
PA#'s 07-157 & 07-158
DRAWING NO.: PT340256
REV: –
DATE: 11/19/94
PLOT SCALE: 1 = 40

22

Reference No. 18

MEMORANDUM TO FILE

Date:	09/12/00
Time:	1650 hours
By:	Crystal K. Roberts, UOS CK
Subject:	Stream flow data for Belt Creek

Text: I spoke on the phone with Pat Ladd, with the USGS in Montana. She told me that at the gauging station 'Belt Creek at Monarch' the mean annual flow of Belt Creek is 191.79 cubic feet per second. This includes 31 years of data.

MONTANA DEPARTMENT OF STATE L
ABANDONED MINE RECLAMATION BUREAU

HAZARDOUS MATERIALS INVENTORY SITE INVESTIGATION LOG SHEET

Mine/Site Name: NEIHART TAILINGS **PA#:** 07-134

Date: June 2, 1993 **Time:** 0715

Field Team Leader: Bullock, Pioneer

Sampling Personnel: Flammang, Pioneer
Clark, Pioneer

Visitors: None

Weather/Seasonality Observations: Cool; cloudy, intermittent rain.

Photographic Log (Film Roll and Photo No.'s/Video Tape Number): #13: SW-1 and SE-1 sample locations, facing west; #14: SE-2 sample location, facing north; #15: TP-1-1, facing south; #16: TP-1-2, facing south; #17: TP-1-3, facing north; #18: TP-1-4, facing south; #19: TP-1-5, facing northwest. Video Tape No. 2

General Comments/Observations (not covered specifically in attached Inventory Forms): N/A

Other Hazardous Materials/Substances Present: N/A

General Comments on Potential Remedial Alternatives: Isolate tailings from alluvial aquifer and Belt Creek, if applicable; cap, revegetate, and cover.

I. BACKGROUND INFORMATION

This information is to be collected to the extent practical prior to conducting the Site Investigation. Data gaps shall be filled in during the investigation.

Mine/Site Name(s): NEIHART TAILINGS PA#: 07-134

Legal Description: T 14N ;R 8E ;Sec. 29 , SW1/4 SW1/4 ___1/4

County: CASCADE Mining District: NEIHART

Latitude: N 46° 56' 30" Longitude: W 110° 44' 40"

Primary Drainage Basin and Code: Belt Creek/10030105
Secondary Drainage Basin: Belt Creek

USGS Quadrangle map name(s): Neihart

Mine Type/Commodities: Mill Tailings Pond

Activity Status: Active___,Inactive/Exploration___,Abandoned X .

Ownership status: Known YX N__; private/public? Private/Public
Owner, Agent, or Contact(include address and phone when available): Richard Bennett, Monarch Co. Inc., P.O. Box 2267, Great Falls, MT 59403. (406) 452-6933; Lewis and Clark National Forest.

Relationship to other mines/sites in the area/district: Unknown

Regulatory Status (Activity by other agencies)? Hardrock permits?
Past Reclamation Activities? Riprap along Belt Creek installed in the 1970's by MDT.

General site features: Elevation 5747', Slope 2°,
Aspect Northeast

Land use: Mining___, Recreational X , Residential X , Urban___,
Agricultural___, Other(Specify)

Area of disturbed/unvegetated lands? Approx. 1.6 acres.
Dimensions: 413 feet x 180 feet

Predominant vegetation types: Cottonwood, Lodgepole pine, willow, some grasses

Access: roads - good X ,poor___,4wd___,trail___.
Other logistical considerations (proximity to other sites). On U.S. 89

Well logs within 1 mile radius; water rights 15 mi downstream (Attach MBMG Well Log Printout(s): There are 3 well logs within a 1 mile radius.

General site geologic, hydrologic, and hydrogeologic settings (Also note presence of radioactive minerals). Site lies on the southwest side of the perennial Belt Creek. Belt Creek flows northwest past the site and is the major drainage for the area. Site is underlain by alluvium and pre-beltian gneiss and schist.

Mining/milling history, ore type/tenor, host rock, gangue: No information available; possibly from the Queen of the Hills Mill.

Mine Operation?

Shafts -	Yes ___,	No X,	# ____,	Comment
Adits -	Yes ___,	No X,	# ____,	Comment
Pits -	Yes ___,	No X,	# ____,	Comment
Placers -	Yes ___,	No X,	# ____,	Comment
Other -	Yes ___,	No X,	# ____,	Comment

Mill Operation? Yes X, No ____. If yes answer the next three questions:

Period(s) of Operation: Unknown

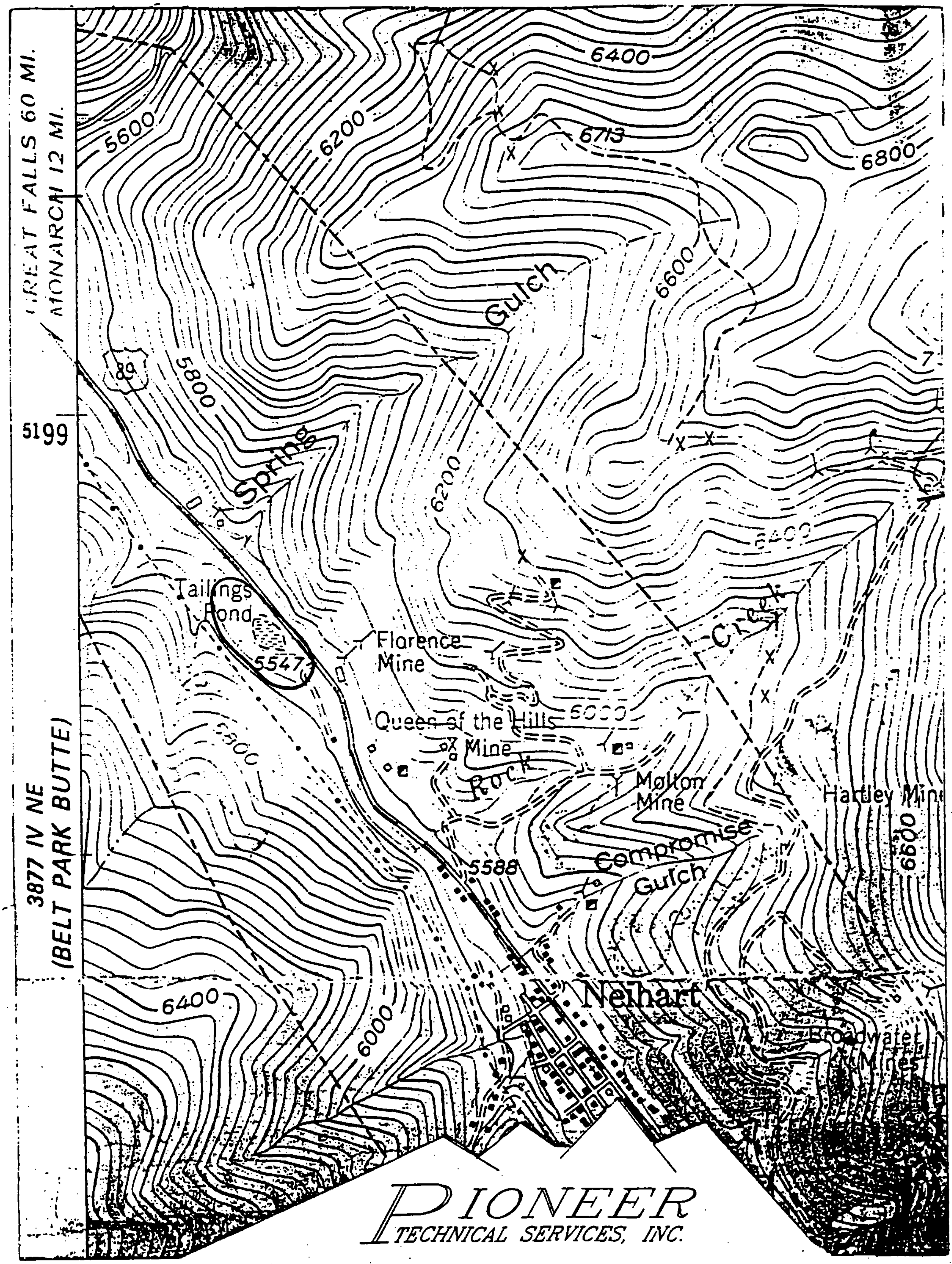
Origin of Ore Milled - Custom Mill___ Dedicated Mill___; Number and names of mines that supplied mill feed: Unknown

Process? Hg-amalgam, CN^- leach (vat, heap), floatation, smelting? Unknown

Montana Bureau of Mines and Geology
Water Well Log Data

10/22/1993

Well No.	Location	Depth	Yield	Static Water Level
M:123062	14N 08E 20 DBA	41.0	4.0	24.00
M:123061	14N 08E 20 DBA	40.0	7.0	0.00
M:25649	14N 08E 32 BDC	120.0	8.0	7.00



PIONEER
TECHNICAL SERVICES, INC.

NEIHART TAILINGS, P.A. NO. 07-134

T14N, R08E, SECTION 29

SCALE: 1" = 1000'

II. INFORMATION COLLECTED ON SITE

A. SOLID MATRIX WASTE CHARACTERIZATION

1. Waste Characteristics - Use table on following page.

Unique source identification (e.g. west waste rock dump #2) and abbreviation on sketch map and source list (e.g. WWRD2). Locate source on sketch map with any measured distances from at least two landmarks.

Source types: Waste rock dumps and piles (WR); tailings impoundments and piles (TAIL); vats, vessels, tanks that contain something (VAT); barrels - not empty (BAR); soils contaminated by spills or leaks (SP); suspected asbestos containing materials (ACM); garbage/refuse/junk dumps (DMP); other sources (OTH).

Source size: Estimated volumes (cu. yards or feet, # of barrels) for each source identified above.

Location/Description: List location and description for each source identified above.

Waste containment: Is the source contained with respect to groundwater, surface water, and airborne releases or the potential to release? Good, adequate, poor, or none. Are waste structures / vessels sound, are runon/runoff controls in place, are wastes covered or vegetated, pond liners intact?

2. TAILINGS IMPOUNDMENTS - If tailings impoundments are also present, complete the following questions.

Describe the tailings grain size distribution(approximate % sand, silt, & clay): Silty sand to fine clay

Determine tailings impoundment depth and describe stratification of the tailings if observable(based on texture and color): Oxidation zone 12"-18" bgs, orange/tan color; gray tailings in reduced zone to depths of 8' bgs.

Are tailings wet or dry (Describe location of partially wetted tailings impoundments): Moist at surface in some areas from precipitation; near saturation in clay pearched zone. Sandy underlying tails are damp, but not saturated.

Describe condition of the tailings impoundment(Note condition of dams or structures, location of breaches): Riprap along Belt Creek in good condition; no containment on TP-2.

Comments on potential for mitigation: Relatively small volume for removal. Possible deep tilling/vegetation or capping due to apparent lack of connection with groundwater.

SOURCE INVENTORY FORM

SAMPLERS: Bullock, Flammang

SOURCE I.D. NO.	SOURCE TYPE	SOURCE SIZE/ VOLUME	LOCATION/DESCRIPTION	CONTAIN-MENT	pH SU (D/S)*	RADIO-ACTIVITY (mR/HR)	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
TP-1-1A	TAIL	22,500	Northwest end of TP-1; 0-0.5', red silty sand	Fair	4.78 (S)	0.05	07-134-TP-1-1	06/02/93 1300	T-Metals, ABA, CN-
TP-1-1B	TAIL		Northwest end of TP-1; 0.5-1', brown silt	Fair	3.9 (D)	0.04			
TP-1-2A	TAIL		Center of pond; 0-1.5', brown sand	Fair	5.79 (S)	0.03	07-134-TP-1-2	06/02/93 1315	T-Metals, ABA, CN-
TP-1-2B	TAIL		Center of pond; 1.5-3.5', red silty clay	Fair	< 3.5 (D)	0.04			
TP-1-3	TAIL		North-northeast along Belt Creek; 0-3.5'	Fair	NM	NM			
TP-1-4	TAIL		South-southwest near diversion; 2.5-7', gray clay	Fair	3.6 (D)	0.04			
TP-1-5	TAIL		South-southeast end nearest to bridge; 3.4-8'	Fair	< 3.5 (D)	0.04			
TP-2-1A	TAIL or CONC	600	Small pile east of main pond, west side; 0-3.5'	None	< 3.5 (D)	0.06	07-134-TP-2-1	06/02/93	T-Metals, ABA, CN-
TP-2-1B	TAIL or CONC		Small pile east of main pond, west side; 3.5-4', tan clay	None	< 3.5 (D)	0.06			
TP-2-1C	TAIL or CONC		Small pile east of main pond, west side; 4-6.5', orange sand	None	< 3.5 (D)	0.04			
TP-2-2A	TAIL or CONC		Small pile, east end; 0-3.5'	None	< 3.5 (D)	0.04			
TP-2-2B	TAIL or CONC		Small pile, east end; underlying soil	None	< 3.5 (D)	0.04			

*D-Direct reading(Kelway Meter); S-Saturated Paste(Orion Meter)

Comments or deviations from SOPs: 07-134-TP-1-1 is composite of oxidized zones from all holes 1-5 in TP-1. 07-134-TP-2-2 is composite of reduced zones from all holes 1-5 in TP-1. 07-134-TP-2 is composite of all of TP-2-1 and all of TP-2-2.

B. GROUNDWATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map or topographic map.

Flowing adits: Yes___, No X , Number:____ Identification:______________

Filled shafts: Yes___, No X , Number:____ Identification:______________

Seeps/Springs: Yes X , No____, Number: 1 Identification: Seep in diversion ditch on west side of tailings which flows into pond; the outlet was sampled as SW-1.

Groundwater wells within 4 miles?: Yes X , No___;
Number of well logs: 13

Distance to nearest well used for drinking? Approx. 100' upgradient

Sample types: Flowing adits (AD); filled shafts (SH);
Residential wells (RW); Monitoring wells (MW); Seeps/Springs (SP).

Field Measurements: Flow (measured or estimated), pH (meter), Eh (meter), SC (meter), temperature (meter), Alkalinity (test kit)?

Potential for groundwater contamination (explain)?
Definite____, Probable X , Possible____, Unlikely____.
Although tailings do not appear to be in contact with groundwater, infiltration of precipitation is highly probable.

Other observations/notes: N/A

GROUNDWATER INVENTORY FORM

SAMPLERS: ______________________________

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SOURCE	FLOW* cfs/gpm	pH SU	SC µS/cm @ 25°C	Eh mV	Temp °C	ALK. mg/L as $CaCO_3$	Depth ft	LAB. SAMPLE NO.	DATE/TIME	ANALYSES
No samples were taken.												

*FLOW: Estimated (E) or Measured (M) from adit, shaft, seep or spring?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): ______________________________

C. SURFACE WATER CHARACTERISTICS

Use table on following page. Identify all locations on sketch map of topographic map. Indicate drainage patterns (run-on/runoff) and directions on sketch maps.

Flowing streams: Yes X, No ___, Name(s): Belt Creek

Dry streambeds: Yes ___, No X, Name(s): ___

Other surface water: Yes X, No ___, Name(s)/Description: Diversion ditch and settling pond along the southwest side of the site

Waste materials within any floodplain: Yes X, No ___ Source ID(s): TP-1

Approximate Flood frequency? ___ 1 yr, ___ 10 yr, X 100 yr

Estimated seasonal flow of stream(s) (cfs)? ___
High Flow: 100+ cfs, Average Flow: 15-20 cfs

Distance between waste source(s) and nearest surface water body (ft)?
20 feet between exposed waste and Belt Creek.

Surface water draining onto or through waste sources: Yes X, No ___,
Describe: Diversion ditch has some tails washed into it.

Surface water use within 15 miles downstream? (Drinking water supply, irrigation, residential use? Sensitive environments within 15 miles downstream? Park, Wilderness, Fishery, Wetland, T&E habitat?)
Irrigation, T&E - Bald Eagles, possible limited fishery

Observed erosional/sedimentation/stream turbidity problems? Yes X, No ___, Distance downstream (ft)? 50 Describe/explain (Note streambank stability and condition of streambank vegetation and any manmade structures or channel changes present): ___
Some sedimentation in the diversion ditch.

SURFACE WATER INVENTORY FORM

SAMPLERS: Bullock, Clark

SAMPLE I.D. NO.	SAMPLE TYPE	DESCRIPTION OF SAMPLE LOCATION	pH SU	SC µS/cm @ 25°C	Eh mV	Temp °C	ALK. mg/L as $CaCO_3$	Flow* cfs/gpm	LAB. SAMPLE NO.	DATE/ TIME	ANALYSES
SW-1	SW	Outlet to Belt Creek of settling pond associated with diversion ditch	6.03	160	315	47°F	36	200 gpm (E)	07-134-SW-1	06/02/93 1345	T-Metals, TDS, Hardness, Cl, SO4, NO2/NO3, CN-
SE-1	SE	Outlet to Belt Creek of settling pond associated with diversion ditch	N/A	N/A	N/A	N/A	N/A	200 gpm (E)	07-134-SE-1	06/02/93 1345	T-Metals, CN-
SE-2	SE	Upradient Belt Creek tailings	N/A	N/A	N/A	N/A	N/A	100 cfs (E)	07-134-SE-2	06/02/93 1415	T-Metals, CN-
SE-3	SE	Downgradient Belt Creek tailings	N/A	N/A	N/A	N/A	N/A	100 cfs (E)	07-134-SE-3	06/02/93 1400	T-Metals, CN-

*FLOW: Estimated (E) or Measured (M)?

Comments or Deviations from the SOPs (Pioneer SAP, 1993): ______

D. ACID MINE DRAINAGE (AMD) POTENTIAL

Evaluate each source in table on next page.

AMD Characteristics:

Presence and abundance of sulfides?	(SO_3)
Presence of evaporative salt deposits?	(ESD)
Discolored or turbid seepage?	(SPG)
Presence of long filamentous algae in drainages, mosses in moist areas?	
Presence of ferric hydroxide precipitates?	(FEOX)
Presence of burned or stressed vegetation?	(VEG)
pH ≤ 5.0	(pH)

General Potential for AMD Mitigation:

Area available for treatment (acres)? Approx. 0.5 acre at northwest end

Wetlands present: Yes X , No ___, Describe: Around and northwest of settling pond (approx. 0.5 acre)

Carbonate rocks/soils: Yes ___, No X , Describe: None apparent

E. AIR PATHWAY CHARACTERISTICS

Population within 4-mile radius: 1-10 ___; 10-30 ___; 30-100 X ; 100-300 ___; 300-1,000 ___; 1,000-3,000 ___; 3,000-10,000 ___; 10,000 or greater ___; Comments ___

Nearest residence(ft or miles)? 50' - part-time, not recently

For each source (table next page):

Available fine materials? Surface area?

Uncovered and unvegetated? Wet or dry?

Overall dust propagation potential:
observed high moderate low none

ACID DRAINAGE/AIR PATHWAY INVENTORY FORM

SAMPLERS: Bullock

SOURCE I.D. NO.	ACID MINE DRAINAGE CHARACTERISTICS (LIST)	MOISTURE CONTENT (WET/DRY/PARTIAL)	SURFACE AREA (SQUARE FEET)	UNCOVERED/UNVEGETATED AREA (SQUARE FEET)	AVAILABLE FINES (YES/NO)	DUST PROPAGATION POTENTIAL (OBSERVED/HIGH/MODERATE/LOW/NONE)
TP-1	ESD in summer; FEOX; SO3; pH	Partial	76,500	70,000	Yes	Moderate when dry
TP-2	FEOX; SO3; pH	Partial	4,000	4,000	Yes	Moderate

Notes and Clarifications:

F. DIRECT CONTACT CHARACTERISTICS

Residents or workers within 200 feet of sources: Yes X , No ____,
Describe: Part-time residents

Population within 1 mile: 1-10___; 10-30___; 30-100 X ; 100-300___;
300-1,000___; 1,000-3,000___; 3,000-10,000___; 10,000 or greater___;
Comments ____

Evidence of recreational use on site: Yes___, No X , Describe: ____

Accessibility - Fences, warning signs, closed roads? Cable gate at bridge

Sensitive environments on-site or adjacent to site:

State or National Parks - Yes___, No X , Comment ____
Wilderness Area - Yes___, No X , Comment ____
T&E Species Habitat - Yes___, No X , Comment ____
Bat Habitat - Yes___, No X , Comment ____

Primary Drainage___; Secondary Drainage X ; No Information___:

Riparian Habitat Quality - High X , Medium___, Low___
Wetlands Frontage - High___, Medium X , Low___
Fisheries Habitat and Species Classification - 3
Sport Fishery Classification - 3

G. SAFETY CHARACTERISTICS

Verify completeness of AMRB Inventory

Hazardous openings: Yes___, No X , Number____, types and locations: ____

Hazardous structures: Yes___, No X , Number____, types and locations: ____

Unstable highwalls, pits, trenches, slopes: Yes___, No X , Number____,
types and locations: ____

Unstable waste piles, impoundments, undercut banks: Yes X , No____,
Number 1 , types and locations: TP-2 is eroding into Belt Creek.

Fire and/or Explosion hazards: Yes___, No X , Explain: ____

Bibliography

MBMG, Geology and Ore Deposits of the Neihart Mining District, Cascade County, Montana, Memoir 13, Written by Paul A. Schafer, July 1935.

MBMG, Well Log Database, September 8, 1993.

MDFWP, Montana Rivers Information System Rivers Report, Version 2.0, Prepared by Montana Natural Resource Information System, December 1989.

MDSL/AMRB, Environmental Assessment Analytical Data for Neihart Tailings, Prepared by MSE, Inc., October 4 and 29, 1990.

MDSL/AMRB Files, Abandoned Mine Reclamation Inventory Field Form for Neihart Tailings, Prepared by Chen-Northern, September 12, 1989.

USGS, Topographic Map, Neihart, Montana, 7 1/2 minute Quadrangle, 1961.

LABORATORY ANALYTICAL DATA

NEIHART TAILINGS
PA NO. 07-134

MDSL AMRB/PIONEER 4/9/93

Neihart Tailings PA# 07-134
AMRB HAZARDOUS MATERIALS INVENTORY
INVESTIGATOR: PIONEER – BULLOCK
INVESTIGATION DATE: 06/02/93

SOLID MATRIX ANALYSES

Metals in soils
Results per dry weight basis

FIELD ID	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/Kg)
07-134-SE-1	27.2	2440	93.1	11.5	15.5	67.7	17100	0.105 U	71500	488	1060	26.2 J	22800	2.277
07-134-SE-2	8	224	1.0	9.33	18.8	14.1	18400	0.062	865	26.9	327	3.93 UJ	528	1.289 U
07-134-SE-3	29.2	600	3.8	9.02	16	29.8	20100	0.049 U	2240	29.7	792	2.87 UJ	1170	1.227 U
07-134-TP-1-1	190	1630	47.4	3.96	7.31	223	33100	0.118	11100	63.4	10100	10.8 J	11400	1.213 U
07-134-TP-1-2	284	984	63.1	17.8	15.3	371	38300	0.121	20700	151	11400	17.4 J	14000	1.283 U
07-134-TP-2	234	38.7	40.7	5.4	4.22	62.7	53600	0.060 U	707	9.14	37400	10.1 J	10400	1.2 U
BACKGROUND	53.3	828	15.3	11.6	72.7	50.1	30600	0.051 U	10400	91.5	5110	2.99 UJ	3530	NR

U – Not Detected; J – Estimated Quantity; X – Outlier for Accuracy or Precision; NR – Not Requested

Acid/Base Accounting

FIELD ID	TOTAL SULFUR %	TOTAL SULFUR ACID BASE t/1000t	NEUTRAL POTENT. t/1000t	SULFUR ACID BASE POTENT. t/1000t	SULFATE SULFUR %	PYRITIC SULFUR %	ORGANIC SULFUR %	PYRITIC SULFUR ACID BASE t/1000t	SULFUR ACID BASE POTENT. t/1000t
07-134-TP1-1	1.64	51.2	17.7	-33.	0.56	0.55	0.53	17.2	0.54
07-134-TP1-2DUP	3.39	106	26.5	-79.	0.15	2.07	1.17	64.7	-38.2
07-134-TP1-2	3.37	105	26.3	-79	0.16	2.04	1.17	63.7	-37.4
07-134-TP-2	4.94	154	-9.0	-163	2.44	0.88	1.64	26.9	-35.9
07-134-TP-2DUP	4.96	155	-9.2	-164	2.45	0.88	1.63	27.5	-36.8

WATER MATRIX ANALYSES

Metals in Water
Results in ug/L

FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC. (mg CaCO3/L)
07-134-SW-1	0.98 U	41.6	3	5.99 U	5 U	8.9 J	223	0.038 U	660	16	12.1	18.3 U	1580 JX	57.3

U – Not Detected; J – Estimated Quantity; X – Outlier for Accuracy or Precision; NR – Not Requested

Wet Chemistry
Results in mg/l

FIELD I.D.	TOTAL DISSOLVED SOLIDS	CHLORIDE	SULFATE	NO3/NO2-N	CYANIDE
07-134-SW-1	86	< 5.0	28	< 0.05	0.01

LEGEND

SE1 – Same as sample SW1.
SE2 – Upgradient Belt Creek Tailings.
SE3 – Downgradient of Belt Creek Tailings.
TP1-1 – Composite of oxidized zone; from holes 2-5 in tailings pond 1.
TP1-2 – Composite of TP2-1all and TP2-2all.
TP2 – Composite of reduced zone; from holes 2-5 in tailings pond 1.
BACKGROUND – From Compromise (07-1000-SS-1).
TP1-2DUP – Duplicate of sample 07-134-TP1-2.
TP2DUP – Duplicate of sample 07-134-TP-2.
SW1 – Outlet of Belt Creek of Belt Creek of settling pond associated with diversion ditch.

XRF ANALYSIS RESULTS

NEIHART TAILINGS
PA NO. 07-134

MDSL AMRB/PIONEER 4/9/93

Mine Name: Neihart Tailings PA# 07-134
XRF Field Analyses
Results in PPM

XRF SAMPLE ID	CrHI	K	Ca	Ti	CrLO	Mn	Fe	Co	Cu	Zn	As	Sr
07-134-SE-1		10342.2	4366.36	1111.51	130.322 *	25956.6	18417			5824.68		165.742
07-134-SE-2		10666	3618.86	1158.69		1137.64 *	18062	410.655 *		343.485		201.479
07-134-SE-3		8856.75	4028.65	2228.78	160.242 *	2715.94	30959.5	452.086 *		628.402		224.02
07-134-TP1-1A		17526.1	2761.91	1540.42		11825	27598.9		93.2186 *	4661.87		215.295
07-134-TP1-1B		17715.5	3178.02	1707.04		3259.86	25933.4			1406.99		200.792
07-134-TP1-1-COMP		18449.3	1954.04	1128.5	167.854 *	8810.79	29274.5		98.5855 *	5193.91		159.287
07-134-TP1-2A	497.2 *	29452.3	3373.9	1985.1		13352.1	36772.5		227.858 *	8560.68		233.209
07-134-TP1-2B		31113.7	4206.1	1823.47	196.952 *	24681.5	35519.8		380.454	13337.5		267.048
07-134-TP1-2-COMP		28044	4122.96	1549.23	247.135 *	26183	33538.4		282.915 *	10824.4		238.429
07-134-TP1-4C		20044.7	3314.02	1545.45		23020.1	27245.2		93.5305 *	3073.03		172.379
07-134-TP1-5D		22556.6	3496.36	2242.86		2209.32	23300			3129.68		206.171
07-134-TP2-1A		41545.6	2021.73	3050.34			43224.1			2773.64		42.1034
07-134-TP2-1B		34006.6	9574.29	3710.16		759.031 *	40785.5			1677.27		40.7432 *
07-134-TP2-1C		36002	5866.09	3451.72		1145.68 *	63602.8			4278.18		52.5453 *
07-134-TP2-2A		36685	8435.12	3629.85		1834.39 *	70456.1	698.796 *		2669.44		58.6146
07-134-TP2-2B		12732.6	3595.36	2387.52	126.335 *		49914.8			467.675	252.823 *	209.871
07-134-TP-1-COMP		35799.4	4198.07	3883.57		934.398 *	57861.4	533.46 *		2767.61		53.4791

	Zr	Hg	Mo	Pb	Rb	Cd	Sb	Ba	Ag	U	Th
07-134-SE-1	151.698			457.703	71.7237			674.146			
07-134-SE-2	125.286			88.4863 *	96.5353			656.477			12.1925 *
07-134-SE-3	413.239			436.23	99.0925			4031.39	184.574 *		16.5392 *
07-134-TP1-1A	192.881			3848.11	92.0719			6631.17	168.969 *		17.8651 *
07-134-TP1-1B	242.88			164.577	104.226			685.336	80.277 *		10.4146 *
07-134-TP1-1-COMP	160.412			4717.24	94.7784		40.1191 *	6458.77	164.842 *		
07-134-TP1-2A	174.005			8298.58	147.568		65.0981 *	6657.73	262.665		
07-134-TP1-2B	150.255			9431.13	136.997	156.977 *	86.4293 *	10675.6	238.714 *		
07-134-TP1-2-COMP	152.267			7439.52	133.193	158.427 *	53.8013 *	10111.7	227.452 *		
07-134-TP1-4C	118.838			1738.32	104.965		56.4407 *	8481.64	135.025 *		
07-134-TP1-5D	285.209			50.0512 *	133.524			743.723	125.504 *	15.1292 *	15.3453 *
07-134-TP2-1A	125.744			2169.64	190.967			227.155	170.968 *		
07-134-TP2-1B	214.705			7331.63	200.773			201.685	175.552 *		
07-134-TP2-1C	156.532			13447.9	207.098			195.122	158.676 *		41.3637 *
07-134-TP2-2A	93.467			11748.8	222.093			339.04	159.339 *		28.6456 *
07-134-TP2-2B	213.641			353.976	85.3122			1048.12	100.312 *		
07-134-TP-1-COMP	125.185			5043.56	217.95			370.856	110.766 *		

* - Estimated Quantity
$ - Unvalidated Data

ABANDONED AND INACTIVE MINES SCORING SYSTEM (AIMSS)
SCORESHEET

NEIHART TAILINGS
PA NO. 07-134

MDSL AMRB/PIONEER 4/9/93

AIMSS SCORESHEET

SITE NAME: NEIHART TAILINGS
PA NUMBER: 07-134

LINE NO.				
		GROUNDWATER PATHWAY		
1	GW - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		0
2		EXCEEDENCES		0
3A		CONTAINMENT		20
3B		GW DEPTH		20
3C		POTENTIAL TO RELEASE	LINES 3A x 3B	400
4		LIKELIHOOD SCORE	LINES 1 + 2 + 3C	400
5	GW - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	128.038
6	GW - TARGETS	WELLS - 1 MI. x 2.5		7.5
7		WELLS - 1 TO 4 MI		10
8		NEAREST WELL		10
9		TARGETS SCORE	LINES 6 + 7 + 8	27.5
10		GROUNDWATER SCORE	LINES 4 x 5 x 9	1408418
		SURFACE WATER PATHWAY		
11	SW - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		300
12		EXCEEDENCES		50
13A		CONTAINMENT		20
13B		DISTANCE TO SW		20
13C		POTENTIAL TO RELEASE	LINES 13A x 13B	400
14		LIKELIHOOD SCORE	LINES 11 + 12 + 13C	750
15	SW - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	140.720
16	SW - TARGETS	DRINKING WATER POP'N		0
17		IMPACTED DRAINAGE		0
18		WETLANDS		10
19		FISHERY		5
20		RECREATION		5
21		IRRIGATION/STOCK		2
22		T & E SPECIES HABITAT		0
23		TARGETS SCORE	SUM LINES 16 - 22	22
24		SURFACE WATER SCORE	LINES 14 x 15 x 23	2321880
		AIR PATHWAY		
25	AIR - LIKELIHOOD OF RELEASE	OBSERVED RELEASE		0
26A		CONTAINMENT		15
26B		DISTANCE TO POPULATION		20
26C		POTENTIAL TO RELEASE	LINES 26A x 26B	300
27		LIKELIHOOD SCORE	LINES 25 + 26C	300
28	AIR - WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	0.927
29	AIR - TARGETS	POPULATION - 4 MILES		30
30		NEAREST RESIDENCE		10
31		WETLANDS		10
32		PARKS / WILDERNESS		0
33		T & E SPECIES HABITAT		0
34		TARGETS SCORE	SUM LINES 29 - 33	50
35		AIR PATHWAY SCORE	LINES 27 x 28 x 34	13905
		DIRECT CONTACT PATHWAY		
36	LIKELIHOOD OF EXPOSURE	OBSERVED EXPOSURE		200
37A		ACCESSIBILITY		10
37B		DISTANCE TO POPULATION		20
37C		POTENTIAL EXPOSURE	LINES 37A x 37B	200
38		LIKELIHOOD SCORE	LINES 36 + 37C	400
39	D. C. WASTE CHAR.	CALCULATED SCORE	(SEE WORKSHEET)	0.843
40	DIRECT CONTACT TARGETS	POPULATION - 1 MILE		30
41		NEAREST RESIDENCE		10
42		RECREATIONAL USE		0
43		TARGETS SCORE	SUM LINES 40 - 42	40
44		DIRECT CONTACT SCORE	LINES 38 x 39 x 43	13488
45	TOTAL SITE HUMAN & ENVIRONMENTAL HAZARD SCORE (LINES 10 + 24 + 35 + 44) / 100,000			37.58

21

LINE NO.		SITE SAFETY		SITE NAME: NEIHART TAILINGS PA NUMBER: 07-134
1	THREAT	ACCESSIBILITY		10
2		OPEN SHAFTS	100 EA.	0
3		OPEN ADITS	50 EA.	0
4	HAZARDS	UNSTAB. HIWALLS / PITS	75 EA.	0
5		HAZ. STRUCTURES	40 EA.	0
6		EXPLOSIVES		0
7		HAZ. MATERIALS		0
8		HAZARDS SCORE	SUM LINES 2 - 7	0
9		POPULATION - 1 MILE		30
10	TARGETS	NEAREST RESIDENCE		10
11		RECREATIONAL USE		0
12		TARGETS SCORE	SUM LINES 9 - 11	40
13		SITE SAFETY SCORE	(LINES 1 x 8 x 12) / 1,000	0.00

SUMMARY OF HISTORICAL ANALYTICAL DATA
FROM OTHER SOURCES

DATE: October 29, 1990

CLIENT: Abandoned Mines

FIELD ID: Neihart Tailings--08/16/90

LAB NO: S2698

DATE RECEIVED: 09-24-90

pH (1:1 slurry) 6.75 SU

Total Metals

As	239	mg/Kg
Cd	14	mg/Kg
Cu	132	mg/Kg
Fe	26,800	mg/Kg
Pb	7190	mg/Kg
Zn	5490	mg/Kg

REPORT DATE: October 4, 1990

CLIENT: Abandon Mines

FIELD ID: Neihart Tailings Downstream

LAB NO: W8568

DATE RECEIVED: 09-14-90

Hardness 67 mg/L as $CaCO_3$

Total Extractable Metals

As	<0.001	mg/L
Cd	<0.0001	mg/L
Cu	<0.01	mg/L
Fe	0.02	mg/L
Pb	<0.001	mg/L
Zn	0.07	mg/L

REPORT DATE: October 4, 1990

CLIENT: Abandon Mines

FIELD ID: Neihart Tailings Upstream

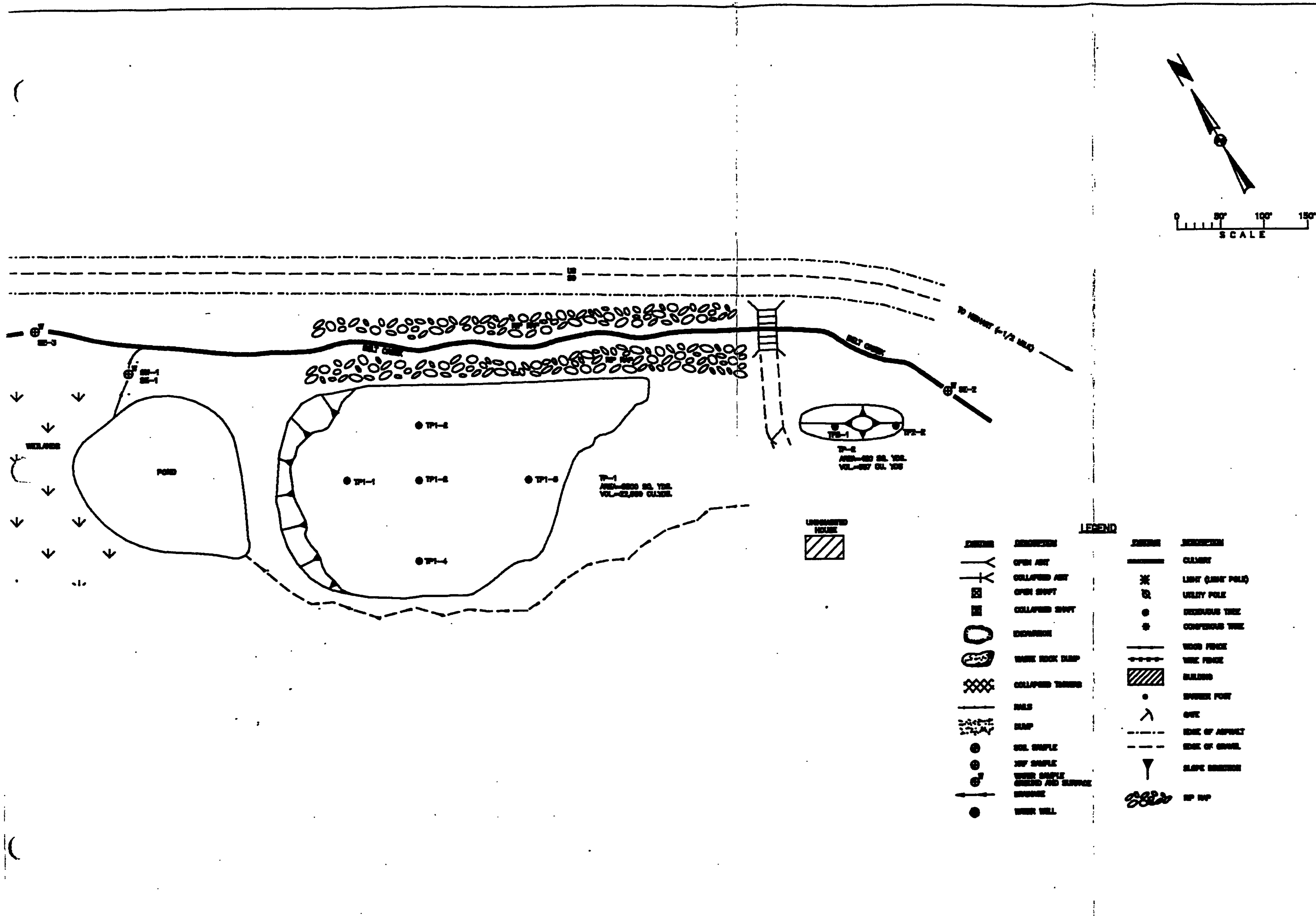
LAB NO: W8567

DATE RECEIVED: 09-14-90

Hardness 75 mg/L as $CaCO_3$

Total Extractable Metals

As	0.002	mg/L
Cd	<0.0001	mg/L
Cu	<0.01	mg/L
Fe	0.04	mg/L
Pb	<0.001	mg/L
Zn	0.06	mg/L



MONTANA DEPT. OF STATE LANDS
HAZARDOUS MATERIAL INVENTORY

NEIHART TAILING PA# 07-134
NEIHART DISTRICT CASCADE COUNTY

PIONEER

DRAWN MWC DATE 8/93
DESIGNED TPR JOB NO. 93-17
APPROVED F.B. NO.

THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS–BOZEMAN–KALISPELL MONTANA
SPOKANE WASHINGTON

TD&H

SHEET NO.

Reference No. 20

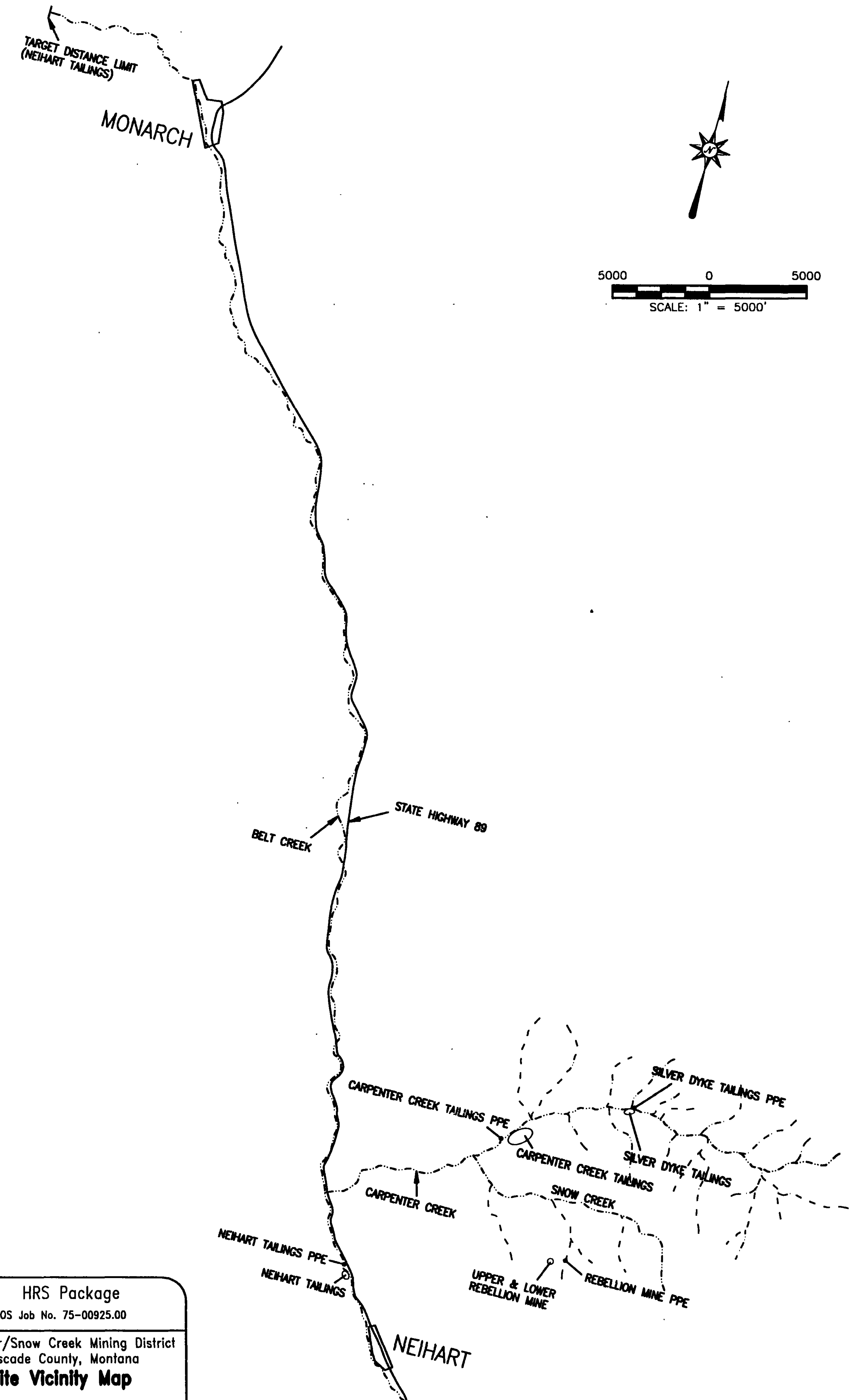
MEMORANDUM TO FILE

Date: 09/12/00
Time: 1100 hours
By: Crystal K. Roberts, UOS CR
Subject: Fisheries in Belt Creek

Text: I spoke on the phone with Tim Bond, with the US Forest Service. Mr. Bond told me that he has personally witnessed people catching fish with the intension of eating them (fish placed in buckets, on creel lines, etc.) many times on Belt Creek between the confluence of Carpenter Creek and the town of Monarch. Mr. Bond estimated that between 5-10 people per day fish that stretch of Belt Creek in the summer time. The last time he witnessed this event was September 7, 2000. As we were speaking he consulted with a colleague, Mike Wofford, also with the US Forest Service, who also said he had witnessed people doing the same. Mr. Bond estimated that 50% of the fisherman do not release the fish they have caught and most likely take them home to be eaten. He also knew of someone personally who has eaten the fish, John Metriom, also with the US Forest Service.

Reference No. 21

URS Operating Services
START2, EPA Region VIII
Contract No. 68-W-00-118



HRS Package

UOS Job No. 75-00925.00

Carpenter/Snow Creek Mining District
Cascade County, Montana

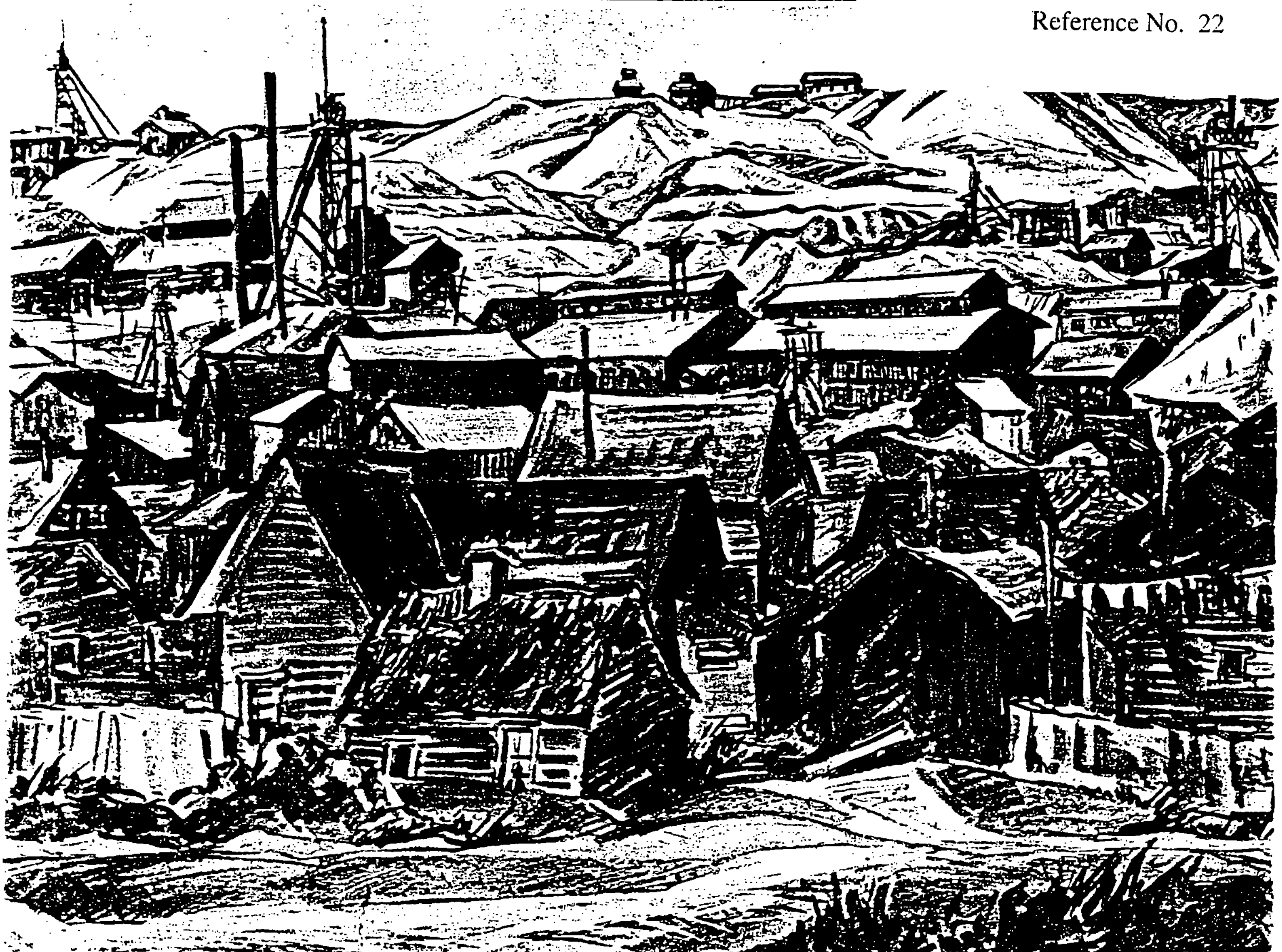
Site Vicinity Map

September 2000

URS OPERATING SERVICES

MONTANA PAY DIRT

Reference No. 22



A Guide to the Mining Camps of the Treasure State

MURIEL SIBELL WOLLE

author of *Stampede to Timberline, The Bonanza Trail,* etc.

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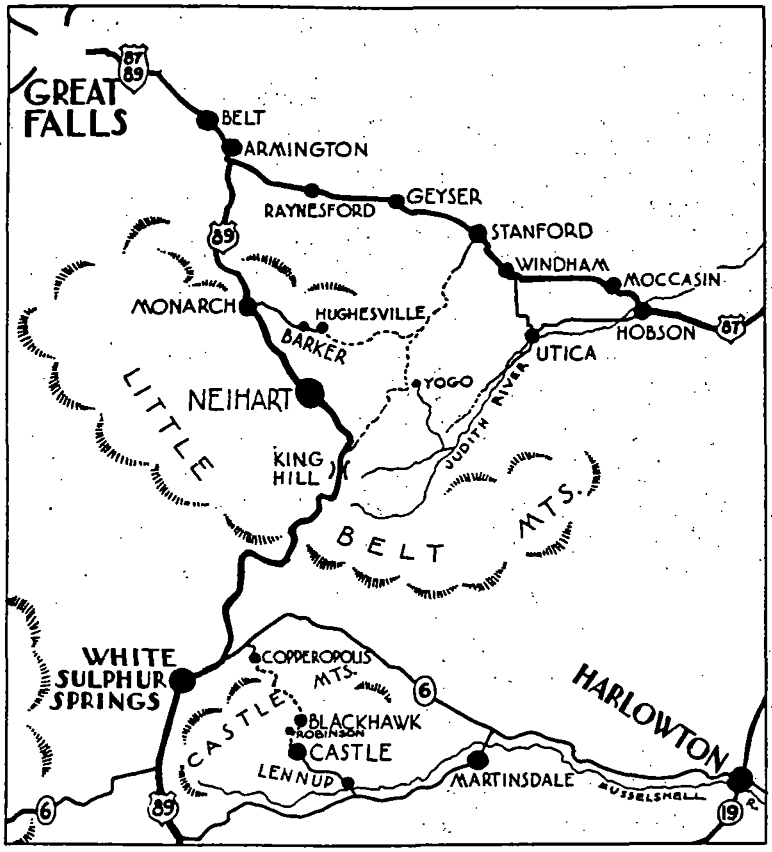


CHAPTER 19

THE LITTLE BELT CAMPS and CASTLE MOUNTAINS

As seen from Helena, the Big Belt Mountains form a solid barricade east of the Missouri River. Farther east and separated by a wide valley, through which runs the Smith River, is the Little Belt Range. In amongst its peaks are tucked several mining camps whose quiet streets attract tourists, fishermen, hunters, and an occasional leaser, and whose busy years are only memories stored in the keen minds of a few old-timers who live in the past.

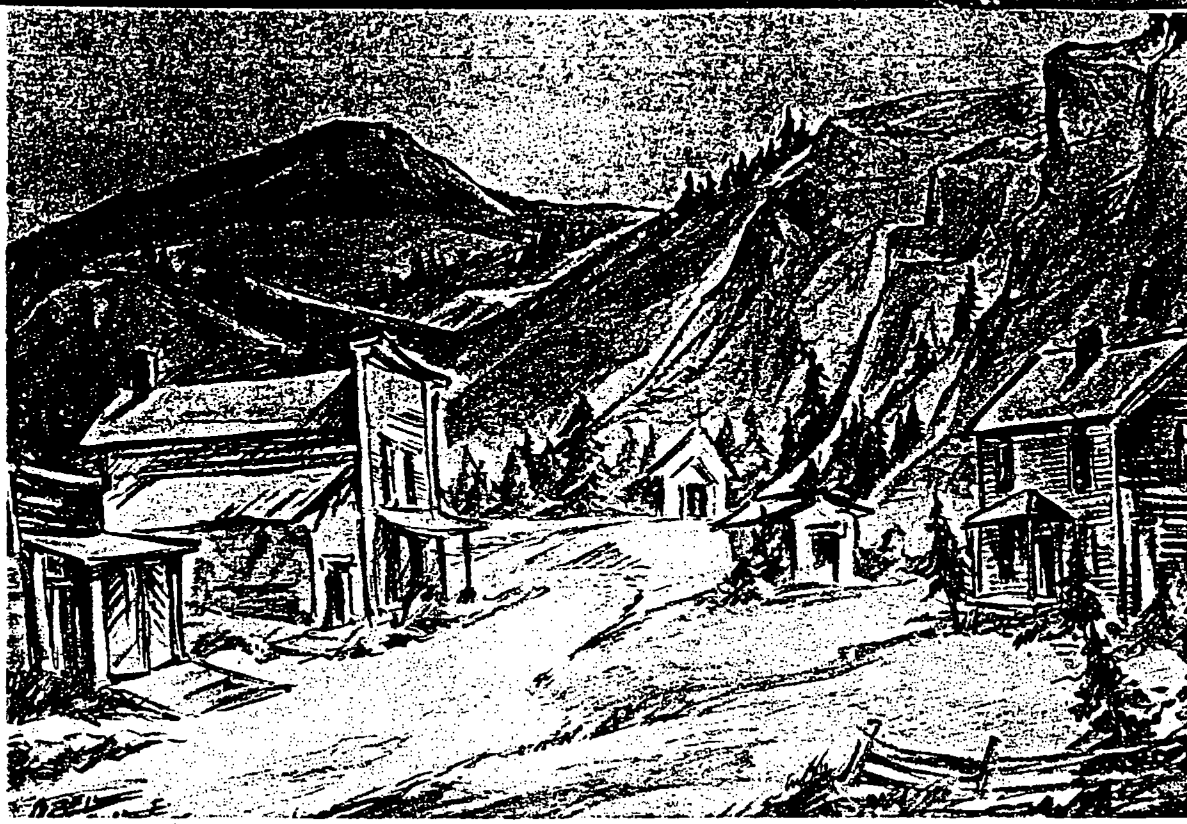
Less than fifty miles southeast of the thriving smelter city of Great Falls, a drive through wheat country brings one to the northern end of the Little Belts where a wooded canyon road crosses a low saddle and drops down to Monarch.

MONARCH

Just outside the camp, two stone buildings and a circular stone kiln or furnace stand back from one side of the highway. The cemetery with its fenced graves hides among trees and shrubs on the opposite side of the road.

The town is just off the pavement and the main street, which parallels the railroad, is dwarfed by the high white and brown limestone cliffs that hem in the canyon through which flows Belt Creek. The railroad station stands beside the tracks, and a small white church with a cross marks one end of the street. Two schoolhouses, one old and one new, guard the opposite end. A large, white house beyond the tracks and close to the depot is the most pretentious building in town. On the main thoroughfare stand a few stores—old false-fronted buildings, some of which hide behind modern facades. In the town garage we found a young woman, Mrs. Gwen Vaughn Rhys, waiting for her car to be fixed and from her learned something of Monarch and of Barker and Hughesville, the two camps which we planned to visit next.

Mrs. Rhys, a Welshwoman who lives in



MAIN STREET,
MONARCH

Barker, told us that there were few roads through the Little Belts even today, but that most of the range could be reached on horseback. The snow was deep in winter and drifted badly. Even as late as June it was often hard to get about in the hills. Monarch was the only settlement in the immediate area. After the railroad was built to Monarch from Great Falls, ore was packed down from the mines to the station and shipped to the big smelter quite easily and much more cheaply than formerly. Mrs. Rhys pointed out the road to Barker and promised us a cup of tea if she got home before we left that camp. Hughesville, she added, was a mile beyond Barker, and though it was quiet now, it had seen several mining revivals since 1905. We thanked her for the information and, after a further look around Monarch, drove back to the main road and turned south.

Within a short distance we turned off the highway and started toward Barker, and as we rode I read from my notes two items dated 1893 from the *Belt Mountain Miner,* the Barker newspaper, each of which dealt with Monarch:

Charley Martin has great hopes of the placer diggings located by himself and others in the neighborhood of Monarch. They have struck a quantity of black sand which is pretty rich. Mr. Martin has disposed of his interest in the Monarch Hotel and will devote all of his time to the new diggings. He will leave for the east next week to procure a new gold-saving apparatus.

November 16, 1893

Last week a shooting scrape occurred in Monarch in which a saloon keeper named Cameron endeavored to bore daylight through J. Mickleson, also of Monarch. After a preliminary hearing, before Justice Schmidt, Cameron was taken to White Sulphur Springs for trial.

September 9, 1891

BARKER and HUGHESVILLE

A thirteen-mile drive up a wooded canyon took us past white granite outcroppings which protruded like great teeth through the forest walls. At one point we heard sheep bleating high above us on the mountain slopes and by peering through the trees we discovered

APPROACH TO MONARCH

the herder's tent and his horses tethered nearby. We broke out of the forest close to a large, terraced settling pond whose tailings were stained many colors and out of whose edges grew scrawny trees. Beyond the pond were the foundations of a smelter and debris from other buildings. Charcoal kilns alongside Galena Creek, below its fork, were also part of this once busy plant. Farther up the gulch were a number of cabins, many more foundations, and the vestiges of two or three streets. This settlement, according to Mrs. Rhys' description, was Barker, but to be sure, I consulted my notes; for on old maps, several camps were shown — Gold Run, Clendenin, Meagher City, and Hughesville. The following clippings were most illuminating:

Clendenin Townsite. The village of Barker is an anomaly in the line of names. All over the state the place is known as "Barker" whereever the camp is spoken of, and it's "Barker" in the newspaper, while really there is no village of Barker. The village is built on the Clendenin and Gold Run townsites and the post office is Clendenin. The Barker townsite, which was platted in June has not been accepted by the county commissioners and Barker's sister town, Hughesville, lies about one mile north. This variety of names, applied to the same place, is not only inconvenient, but is mystifying to the stranger. . . . If Buck Barker's spirit visits the valley it will find that his name has been fixed on this camp and will forever remain.

Belt Mountain Miner, October 28, 1891

The first discovery of metals in the Little Belts was made by Patrick H. Hughes and E. A. "Buck" Barker, who left the Yogo District, where they had been prospecting without success, and set out to find new placer fields. On October 20, 1879, they camped on Galena Creek, a tributary of the east fork of the Belt River. The following day, while Barker went hunting, Hughes searched for placer ground, and finding a location that he liked, started to run a drain to it. While digging, he noticed lumps of galena mixed with the earth. This encouraged him to look for the ledge from which they came, which he found and named the Barker. The Grey Eagle adjoined the Barker at the center of the creek, but from there the two claims ran "into the hills in opposite directions."

Soon after these initial discoveries, H. L. Wright and H. K. Edwards discovered the Wright & Edwards lode a "short half-mile from the Barker on the same mountain." Oscar Olinger, Pat Donahue, and August Okerman located the Homestake lode, above the Barker, and the Hancock, Maggie, Summit, and the DeSoto. Placers were also discovered, but they were unimportant; it was the ledges and lodes that carried the most valuable deposits. By 1880 nearly one hundred men were working in the gulches of the area, and several hundred locations had been made. By the fall of 1881 a reporter from the *Benton Weekly Record,* having obtained directions at Baptiste's place, "fifteen miles outside the mines," went to see the new camp in November.

From the very mouth of the gulch up to Gold Run the way is very bad, yes, outrageously bad for over ten miles. Freighters who try it once declare that it is the last trip unless they are paid five cents a pound to compensate them for the risk.

There was a foot of snow in the gulch by the time we reached "Dog Eating Jack's" and still it was snowing when we arrived at the smelter. . . . There being no hay in the camp, nearly all the teams had been sent out to feed. . . . The sound of a steam whistle and the sight of mechanics going to labor with timed regularity conveys some idea of the changes in camp within the last six months. The smelter with its enormous brick chimney and iron pipes, loomed up immensely as I drove into Gold Run.

Four towns prosper — Gold Run, like villages of New England, is proud of its smoke stacks and the quiet of its people. It is the headquarters of the smelter.

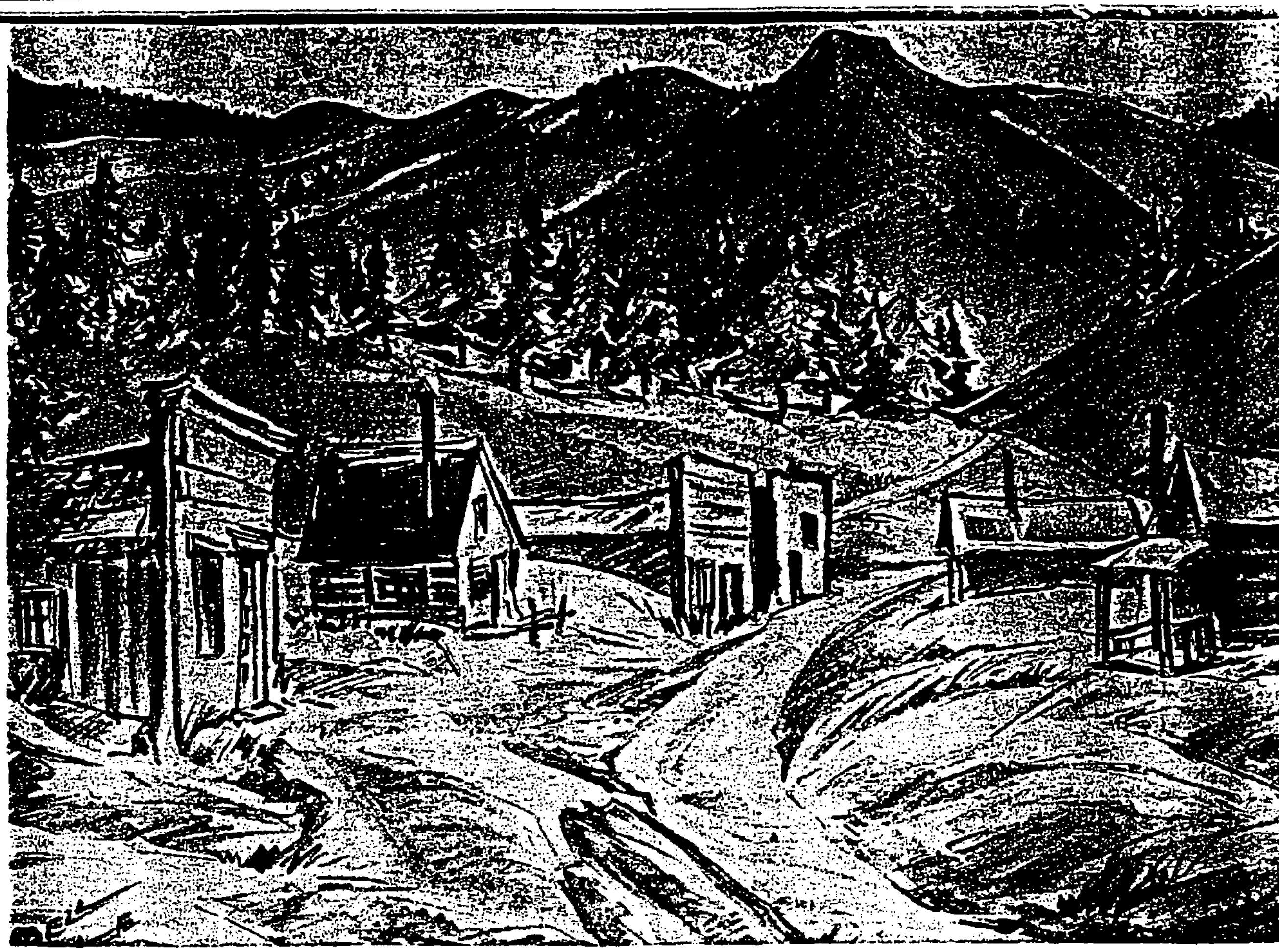
Meagher City is noted for its beautiful avenue and is the kind of a town where a rich man would build a residence and take a wife to live. She would be two miles from the bustle of Gold Run and nearly a mile from the rougher element; perchance dominant at Hughes City.

Galena lies down in the gulch below the hill in front of Meagher. It looks like a part of Deadwood in having its houses dotted about on the mountain sides and in the gulch — irregular but picturesque. There is not much business in Galena as yet but its people are sanguine.

Hughes City is the town just now. It is at Hughes City that the old Colorado miner meets the Nevada pioneer and compares the prospects of Barker with the Georgetown or Eureka mines. . . . It is the place where gambling is indulged in and the black eyes come from. It is in Hughes City that a miners' meeting is held and it is agreed that if any man works for less than $2.00 a day he shall be run out of the camp.

During my stay I went up to the Wright & Edwards mine. . . . Ore is being taken out and a pile of over 200 tons beautifully built up under the ore shed, shows the wealth of the lead.

Mail facilities are badly lacking in the camp, and our Benton people should help this District as far as possible.



BARKER

My horse was at the foot of the trail at Allis' ranch so I had to get out of the District on foot. This was no easy job with a buffalocoat, a gun, s me cartridges and two feet of snow to pull through, but I managed to get from Gold Run to Hughes City.

Another year will place the Barker District on a footing it surely is entitled to . . . a good road can be made over the trail for light teams. The estimated cost of this improvement is $2500. The present roundabout way of entering is needlessly long except for freighting. . . . It is discouraging to the Barker people to have to do every single thing without a particle of outside aid.

Benton Weekly Record, November 10, 1881

Two weeks later the correspondent's second letter was printed:

Barker mining district is taking a quiet little boom. . . . Most of the business is done in Hughes City at present. . . . There are two stores, [and] two saloons besides Capt. Foly's billiard parlor. . . .

Gold Run has a well-appointed store. There is also a saloon kept by Pete McDermot where the boys do congregate to while away the time in a friendly game of draw and to quench their thirst occasionally. Gold Run has also a law office. . . .

We had quite a nice dance here about two weeks ago and all enjoyed themselves hugely. Some of the boys wore loud neckties. Judging from the white spots on some of their heads, it's a long time since some of them were boys.

P. H. Hughes has built him a comfortable residence in Meagher City where himself and Mrs. Hughes are snugly domiciled.

Yours,
Endymion
Benton Weekly Record,
November 24, 1881

The Clendenin smelter, built during the summer of 1881, was blown in late in November. Built by George Clendenin of the Clendenin Mining & Smelting Company, it helped develop the district by producing many tons of bullion from the several large mines which fed it silver-lead ore between 1881 and 1883. According to James Arthur MacKnight, it operated for eighteen months.

Although a failure, it ran out in that time $375,000 worth of bullion. Whether a monument to folly or inexperience, it failed and buried Barker in obscurity for over seven years.

J. A. MacKnight, *Mines of Montana,*
National Mining Congress, July 12, 1892

With high transportation and smelter costs, only the richest ore was freighted out and, after 1884, when the deposits at Neihart were discovered and men rushed across the mountains to be in on the new strike, the camp of Barker began to decline.

With the completion of a silver smelter at Great Falls in 1888, plans were made for the construction of the Belt Mountain branch of the Great Northern road as far as Barker. This road was completed on October 1, 1891, and "although few mines were in condition to ship ore and not sufficiently developed," the station agent's books showed 1,280 tons of ore shipped out during October. The Barker mine was operating in 1891, for "the Shriek of Steam Whistles, Hum of Wheels and Creaking of Cables at the Barker Hoist" was mentioned in the local newspaper. The Paragon was also active, with "200 tons of ore on its dump." The same year, T. A. Lusk, a mining expert from Milwaukee, visited several of the mines, and after conferring with the owners of the Moulton, "succeeded in bonding these properties for six months. The group consisted of the Bellefont, Harrison, Moulton and Pioneer."

The Belt Mountain branch of the railroad revived Barker. Even before the last construction crews pulled out, curious visitors from Great Falls tried out the road:

The Great Falls Bicycle Club Takes an Outing Among the Belt Mountains.

During the last week the Great Falls Bicycle Club organized a Sunday excursion to Barker. The train arrived at the Barker depot about 12 m. and most of the visitors immediately repaired to the hotel for refreshments, others being entertained at private homes.

Promptly at 1 o'clock teams were in readiness to transport passengers to the mines. Many however were unable to find seats in the carriages and were obliged to walk, a few members of the club mounted their wheels and successfully rode the hill between the lower camp and the mines.

The Barker being nearest the railroad terminus was visited first. Here T. W. Maloney, the gentlemanly foreman, received the sightseers and conducted them through the tunnel, explaining the workings. . . . All were interested in an examination of the ore dump, the ladies especially being anxious to obtain specimens of the ore. Here again Mr. Maloney had occasion to render assistance, as the ladies invariably selected the shining pyrites rejecting the less attractive but valuable galena. Continuing on the road up the canyon the party soon arrived at the Carter. . . . A chamber 14 feet square and from 8 to 12 feet high, cut in solid ore is a rare sight even for experienced mining men and for those not familiar with mineral bodies the contemplation of so many embryo silver dollars is pleasing in the extreme.

The train was due out at 4 p.m. . . . Capt. Matteson and Mr. Mitchell of the bicycle club on their wheels, took the trail for Monarch, intending to board the train at that point. They left at a speed that should have caused the locomotive to blush with humiliation and though we have not since heard from them we have no doubt they reached their destination in safety.

The excursion party was made up of the elite of Great Falls, and represented the best class of society that Montana or the world affords.

Belt Mountain Miner, September 23, 1891

With the arrival of the railroad, the various camps on Galena Creek grew together into what the *Belt Mountain Miner* described as a "substantial town." The principal store was that of F. J. Henzlik. The lower floor was devoted to drygoods and groceries, while the upper floor was divided into "nine pleasant rooms all ceiled and sided with red wood." Probably Mrs. Minta Bolton, conducted her dressmaking establishment in her home. Her advertisement in the paper stated:

I desire to announce that I am prepared to make a limited number of fine dresses. Perfect fit and eastern prices guaranteed.

November 25, 1891

Even when the waterworks were completed, no organization was set up to cope with fire.

Last Sunday evening, while the paper hangers were at work on the second floor of Silver & Co.'s new building, a large Rochester lamp which they were using exploded, throwing the boiling oil over the room. The whole room was in a blaze.

Belt Mountain Miner, December 9, 1891

Destroyed by Flames.

About 8:30 Sat. evening Mike Sund . . . noticed smoke issuing from the rear of F. J. Henzlik's store and residence building. . . . The alarm was given and in a few minutes nearly all the people in the camp were on the ground fighting the flames and saving what they could. . . . Within an hour the stores of F. J. Henzlik, Thisted, Brosnan & Co., and Barker Meat Co. were burned to the ground.

That evening . . . for the first time in the history of Barker the fearful cry of fire rang out on the frosty air. . . . People seemed to be at a loss at first how to act, it being the first fire, and there being no organized fire apparatus. The dry pine building made the little water at hand practically useless, but nearly everyone carried a bucketful before they realized the fact.

The origin of the fire was obviously a lamp explosion.

For three years Barker has been going to organize a fire brigade, and now that there has been a fire, it may have a tendency to wake people up to the situation. . . . At this fire there were about 30 captains and 3 firemen and of the latter, John the Chinaman was one of the best.

Belt Mountain Miner, November 3, 1892

The praise given to John Chinaman as a fire fighter is unusual, for most mining camps were hostile to the Chinese within their boundaries and seldom singled them out for commendation. Two other items from the paper indicate Barker's attitude toward Orientals, possibly because the camp had but one such resident.

The Chinaman's Sign

A short time ago Ah Lee the inoffensive celestial who runs a laundry in Barker, left the camp for a visit elsewhere. . . . When he returned to camp he found everything as he left it except his sign.

Belt Mountain Miner, July 13, 1892

The article continues by stating that the stolen sign was returned.

Last Thursday was the Chinese New Years and John, the lone Chinaman of Barker, celebrated it in great style. He kept a good supply of Chinese and American liquors and other Chinese refreshments on tap and all his friends and customers were invited in to share in the good things.

Belt Mountain Miner, February 23, 1893

Like all new and isolated communities, the people of Barker and the nearby camps arranged their own amusements; which were duly recorded in the *Miner*:

Annual Ball

McHughes' hall was tested to its utmost to accommodate the gay throng of pleasure seekers. With a few exceptions the people of Hughesville and Barker joined and made this the most successful and pleasant occasion enjoyed for years. Waltz, quadrille, polka, schottische and newport followed in rapid succession until the musicians were glad when supper was announced. The tables of the Clendenin hotel were loaded with every delicacy of the season . . . to which all did ample justice. After supper, dancing continued until about 5 a.m.

Belt Mountain Miner, January 6, 1892

A masquerade ball was given at Monarch Wednesday night. A number of Barker people brushed up their old costumes and went down. Some of them went as God made them and appeared fittingly for the occasion.

Belt Mountain Miner, January 5, 1893

The Show That Didn't Come.

Many were on the street in front of the hall and a thermometer that registered 30 degrees below zero an hour before the time. When the disappointing news came that the "company" would not come, the pause that followed was so silent that one could hear a pistol shot a rod away. . . . Then the crowd went away and we were glad, for we had been asked about thirty times in ten minutes what a 'soubrette' was, and having no more idea than the questioners, we told them to wait and we would show them.

Belt Mountain Miner, February 2, 1893

HUGHESVILLE MERCANTILE CO.

A description of the district's mines as of 1892 is given by James Arthur MacKnight:

When the passenger alights at the Great Northern depot at Barker he finds himself under the shadow of a towering mountain, lying to the south. This is Manitoba mountain, taking its name from the Manitoba mine, which one can see about 600 feet above. This mine was discovered three years ago (1889) and sold to E. J. Barker, who organized the Ontario Mining Company for the purpose of working it.

From the depot the road passes up Galena creek, through the camp of Barker for two and one-half miles to the Silver Bell mine . . . located October 13, 1880, by H. C. Foster. . . : On this mine are two sets of workings. The upper work consists of about 1400 feet of tunneling on a blanket load of lead carbonate ore in limestone. From these workings in 1883 were taken 2500 tons of ore which was worked at the Clendenin smelter. The lower workings consist of a shaft 180 feet deep, with several hundred feet of levels. From these workings were taken 420 tons of ore in 1883, but it was too base to be worked by the Clendenin smelter, though some of it carried 200 ounces of silver. It laid on the dump until the advent of the railroad in 1891. So far in 1892 it has yielded about twenty cars of ore.

A mile above is the Wright and Edwards mine, known as the "P" Mining Company, owned by U. S. Senator T. C. Power. This mine was located in 1880, and for the benefit of the Clendenin smelter put out 2700 tons of ore with an average value of forty-two ounces of silver and forty-eight percent lead.

Around the hill and up the creek a quarter of a mile, in the same granite belt, is the Barker mine, owned and operated by Paris Gibson, T. C. Power and C. X. Larrabie. This was the first mine discovered in Barker. . . . In 1883 it yielded 300 tons of ore that assayed sixty-five ounces of silver and forty percent of lead.

Across the creek from the Barker is the Queen Esther property, organized in June, 1891. . . . Next above the Barker is the Carter. . . . Up the east branch of Galena creek is the Tiger.

Mines of Montana, National Mining Congress, July 12, 1892

By January, 1893, the *Miner* stated that Barker was "becoming the great transportation point of the Judith Basin." Yet only a few months later business on the railroad fell off to such an extent that service was cut to one train a week. On December 21st, without warning, the

Railroad Station Closed

This means that after today there will be no regular trains run between Barker and Monarch. . . . This has been contemplated for some time. . . . We are in hope that it will not be long until the shipments of freight will be sufficient to warrant the re-opening of the station.

Trains between Great Falls, Monarch and Neihart will continue as heretofore.

Belt Mountain Miner, December 21, 1893

The loss of the railroad, coupled with the silver slump, nearly finished the Barker District. The editor of the *Miner* tried to rally the mine operators by taunting them:

What's the Trouble With Barker?

Neihart is fast coming to the front as a silver producing camp. . . . The Neihart ores are principally dry, and the smelters must have lead ore in order to successfully treat such ores. Barker is a silver-lead ore camp, (containing) large bodies of ore which can be treated at smelters at very small cost.

Belt Mountain Miner, January 6, 1894

His exhortings failed to save the situation, and three weeks later, he admitted himself licked:

J. E. Sheridan, Lessee

To the Public

As the business of the camp will not longer justify the publication of a newspaper, we have decided to temporarily suspend the publication . . . with this issue. We are hopeful that the price of silver will advance sufficiently to warrant mine owners in the district in resuming operations in which event we will be "on deck" to keep the ball rolling and assist as far as we are able in showing to the world that the Barker district has as large and good paying bodies of ore as can be found in any camp in the West.

Adieu.

Belt Mountain Miner, January 27, 1894

That the district was fairly quiet no one could deny although some mining was carried on, especially in the Tiger and Moulton properties. Both were worked under lease, as were others in later years, for short intervals of time. Several million dollars worth of ore in all was produced by the camp, chiefly from the Wright & Edwards mine (later known as the "P" property). This mine was worked until 1930.

My only visit to Barker and Hughesville was in 1955. A mile above Barker, in Hughesville, I found both old and new houses near the road and across the creek as well as several false-fronted stores and one empty building with leaded glass windows. Mine dumps and mine buildings were not far away, and up ahead, where the road swung around the shoulder of a hill, was the big yellow dump of the "P" property, topped with a shafthouse.

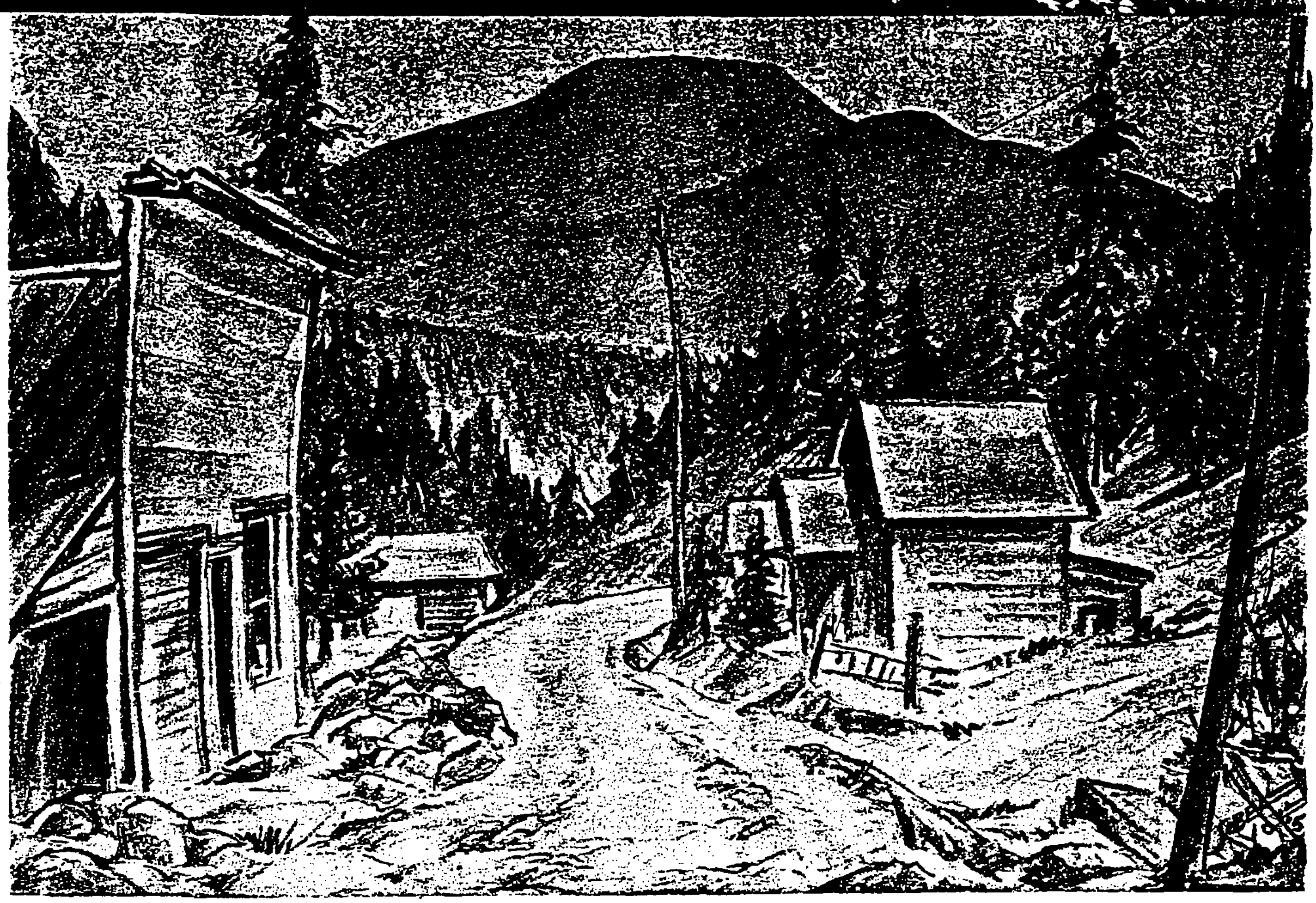
On the return drive to Monarch, we met but one car — that of Mrs. Rhys. We waved as we drove by, disappointed that we could not stop for tea and hear more about the district's history.

NEIHART

Straight south from Monarch, a fine road (Highway No. 89) winds for miles, following Belt Creek through a forest canyon where private cabins, set among the trees, are the only signs of habitation. On the outskirts of the mining camp of Neihart are mills and dumps — the usual approaches to all such towns — while on either side of the main street stand many old buildings, some boarded up, and others which serve the small but permanent population.

Neihart is set in the bottom of a canyon and cut by a stream. High, timbered mountains rise on all sides of it, dwarfing its weathered frame buildings. We drew up at a store in front of which stood several cars and a truck. This place seemed to be the town rendezvous, and inside I hoped to find someone whom I could question about Neihart's past. Francis found a Mr. Sutton, a gentleman of seventy-six, who said he'd been in Neihart since he was six years old. Taking us outside, he pointed up and down the thoroughfare, whose weathered board sidewalks, flanked by vigorous weeds and tall grass, led from store to store or stretched in front of vacant lots, which were so overgrown with brush that stone foundations of former buildings were all but hidden.

"This street used to be solid with buildings and so did the side streets," he said. "There



HUGHESVILLE

was a railroad into the town, too. At one time, Neihart was bigger than Great Falls. This was a silver camp. The mills recovered only silver and let the zinc and lead go, until World War I. Then they reworked all the dumps. There was a lot going on around here between 1935 and 1937, and again in 1946, when a Canadian outfit came in and bought up sixteen properties. It planned to drain the lowest one and then work through a cross-cut tunnel. There's very little mining going on here now." With this briefing, he left us and went back into the store.

Prospectors have restless feet, so perhaps it was only natural for James L. Neihart, John C. O'Brien, Richard Harley, and a few others to leave the mining camp of Barker in the summer of 1881 and work their way across the intervening hills to a gulch which to them looked promising. There, on June 15 or July 6, 1881 — authorities differ as to the date — they located the Queen of the Hills, a silver-lead deposit and the first mine to be staked in the region. As soon as the news reached Barker, several parties of men equipped themselves and set out for the new location, where, upon arrival, they staked out many claims within the next few weeks. The Homestake mine, 500 feet above the Belt River, contained "black and red sulphates, easily taken out and worked." The discovery shaft of the Queen of the Hills adjoined the Homestake. A horn silver ledge, the Montana Belle, was one of the best in the district.

Perhaps the most explicit description of the region in its infancy is given by O. G. Mortson. He mentions Canyon City. Since the miners held no official meeting until the following spring, this name was probably the first to be applied to the settlement that we know as Neihart.

At present the route from the Barker district to this place is by pack animal, and goes over the low pass on the left bank of the Dry Fork about three miles below the smelter, and then across a hilly trail to Belt Creek, crossing which we arrive at the Park with its picturesque scenery . . . proceeding almost to the head of the Park, and arriving at Harley creek, (we) arrive at the western limit of the mines, and descend into Belt creek which we follow upstream two miles to the future site of Canyon City.

The characteristic rocks in the camp are essentially granitic, at the eastern boundary changing to quartzite.

At Canyon City . . . nineteen distinct veins have been discovered on which are eighty locations. . . . Messrs. Neihart & Co.'s locations give an assay, I hear, of nearly $1,000.

Parties visiting the camp this fall pointed to the absence of live timber as a great draw-back to the camp. A stream flows through the center of the camp (and) six miles upstream exist untouched forests. One-and-a-half miles west of Canyon City, Fly or Carpenter's creek enters the Belt river from the northeast.

Belt Park District. This pioneer district on the main Belt, was discovered May 14, 1881, by Messrs. Carpenter and Aldrich. At present in its infancy, it has 33 locations.

Benton Weekly Record, November 17, 1881

"By April 7, 1882, most of the locations in the camp had been made," writes D. B. Mackintosh, in the Souvenir Edition of the *Neihart Herald* in 1895. "That day we held our first town meeting. . . . J. C. O'Brien, seated on a rock was the chairman of the meeting and I, as Secretary, lay at full length upon the ground. The Secretary moved that the town be called Farragut. . . . This motion did not receive a second. Hamilton moved that it be called Neihart." This was accepted.

The limits of the town (were set at) Harley's creek on the west and O'Brien creek on the east. . . . Two lots are all that any one man is entitled to take up in the same townsite. All persons taking up town lots shall fence and record them within 40 days. . . . Plans have been made to plat the town and survey it and keep a book of records. Main St. is to be 80 feet wide and cross streets 60 feet wide.

Rocky Mountain Husbandman, April 20, 1882

Mackintosh continues his reminiscences in the *Herald*:

The first log shack was built by Ed Tingal in what is now called Jericho. . . . In June, 1882, the business men of White Sulphur Springs employed M. L. Sohmers to cut a trail from Sheep creek into the camp. Later on these same men contributed $1100 toward building a wagon road from the Smith river to the head of O'Brien creek, which road was built by James Brewer, the men of Neihart building up that creek to join Mr. Brewer at his terminus.

Our supplies were brought from Barker over the trail on horseback. In October, James Chamberlain brought the first team and wagon over the range from White Sulphur Springs.

In August, 1882, Reverend W. W. Van Orsdel, superintendent of the North Montana Mission of the Methodist Episcopal Church, held two meetings in a log cabin.

Both services were free from tinsel, fuss or feather and there was no visible presence of the golden calf of jewish history. Saint Paul or Peter in their working clothes would have felt perfectly at home, and in either would have been given a front seat.

Neihart Herald, Souvenir Edition, 1895

The first woman to visit the camp was a Mrs. Leach. She rode horseback man fashion. Either this picturesque way of traveling or her husband's propensity for interfering with other men's claims, made Mr. and Mrs. Leach rather unpopular and their stay in camp was short.

Neihart Herald, Souvenir Edition, 1895

For the first year or two the camp had no regular mail service. Prior to the summer of 1884, when William Woolsey received the contract to carry it between White Sulphur Springs and Barker via Neihart, mail arrived whenever anyone bothered to bring it in from the nearest office. A sack was sometimes dropped off along the trail by some volunteer carrier, knowing that whoever found it would open it. If the contents was addressed to the destination to which he was going, he might tote it there, otherwise he would hang it in a tree to await the next passerby. One bag of mail, which left Neihart in November 1883, reached White Sulphur Springs, forty-two miles away, in June of 1884, "having spent the winter on the range."

Mackintosh opened the first store in a small log cabin with a dirt floor. "Poles served as shelves and a door did duty as a counter. The first stock of goods came from the firm of F. W. Reed & Co. of Barker. A few days after shipping the goods, the firm failed, and for several days thereafter, a brisk and lively trade went on at the log shack, the general fear being that the lawyers would take the goods from camp."

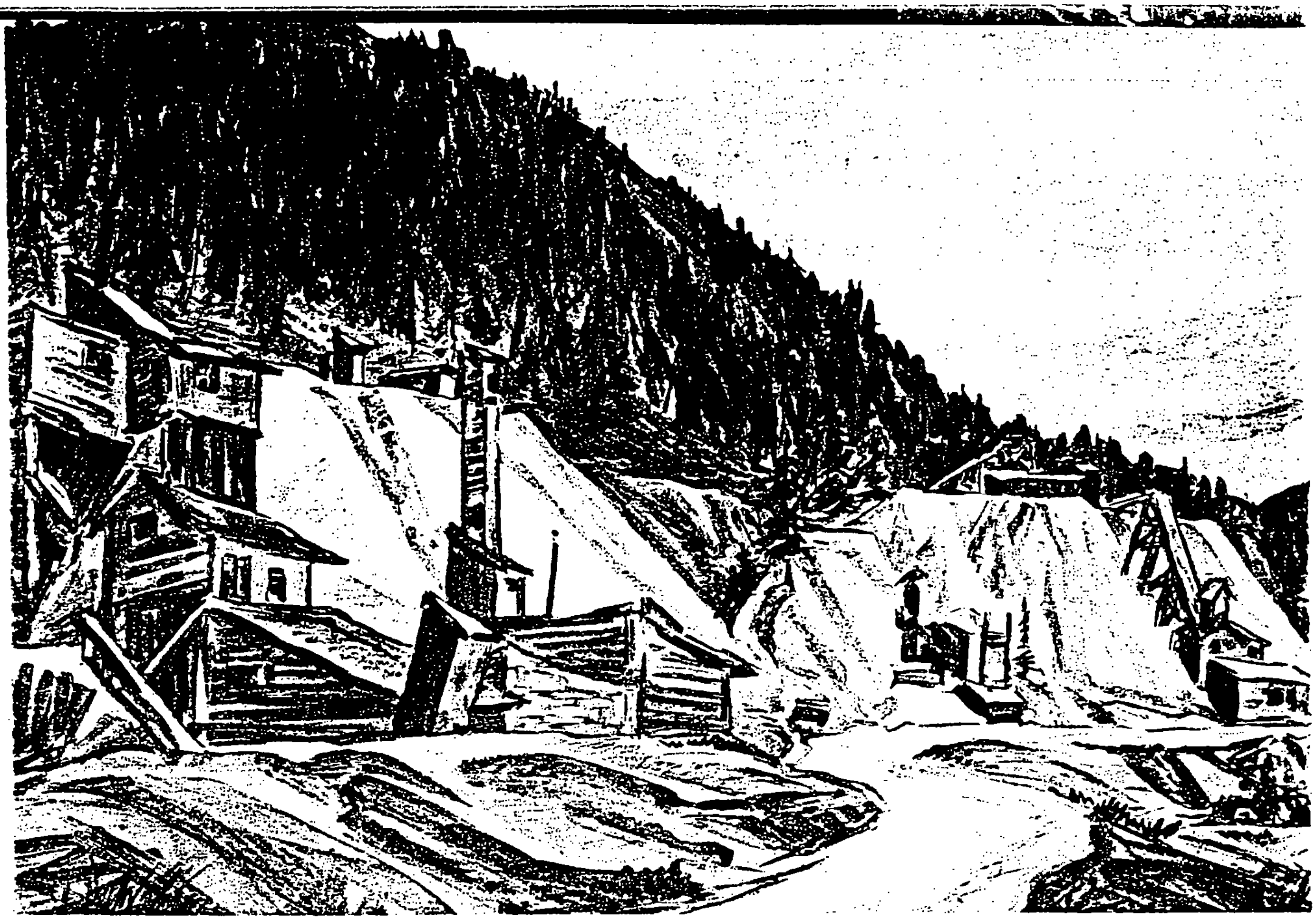
In 1885 the *Rocky Mountain Husbandman* described the camp's growth. The Fort Benton paper copied the article:

Neihart has 2 saloons, 2 eating houses, 1 private boarding house, a post office, 1 store, 1 blacksmith shop, 1 chinese wash house, 1 barber shop, 1 butcher shop, 2 stables, 24-25 houses with roofs and as many more without, and a number of tents. Dwellings are of a primitive nature, small log houses covered with poles and dirt, and the place looks for all the world like a new placer camp.

There is plenty of room for a town and the creek bottom is staked into town lots for a distance of five miles.

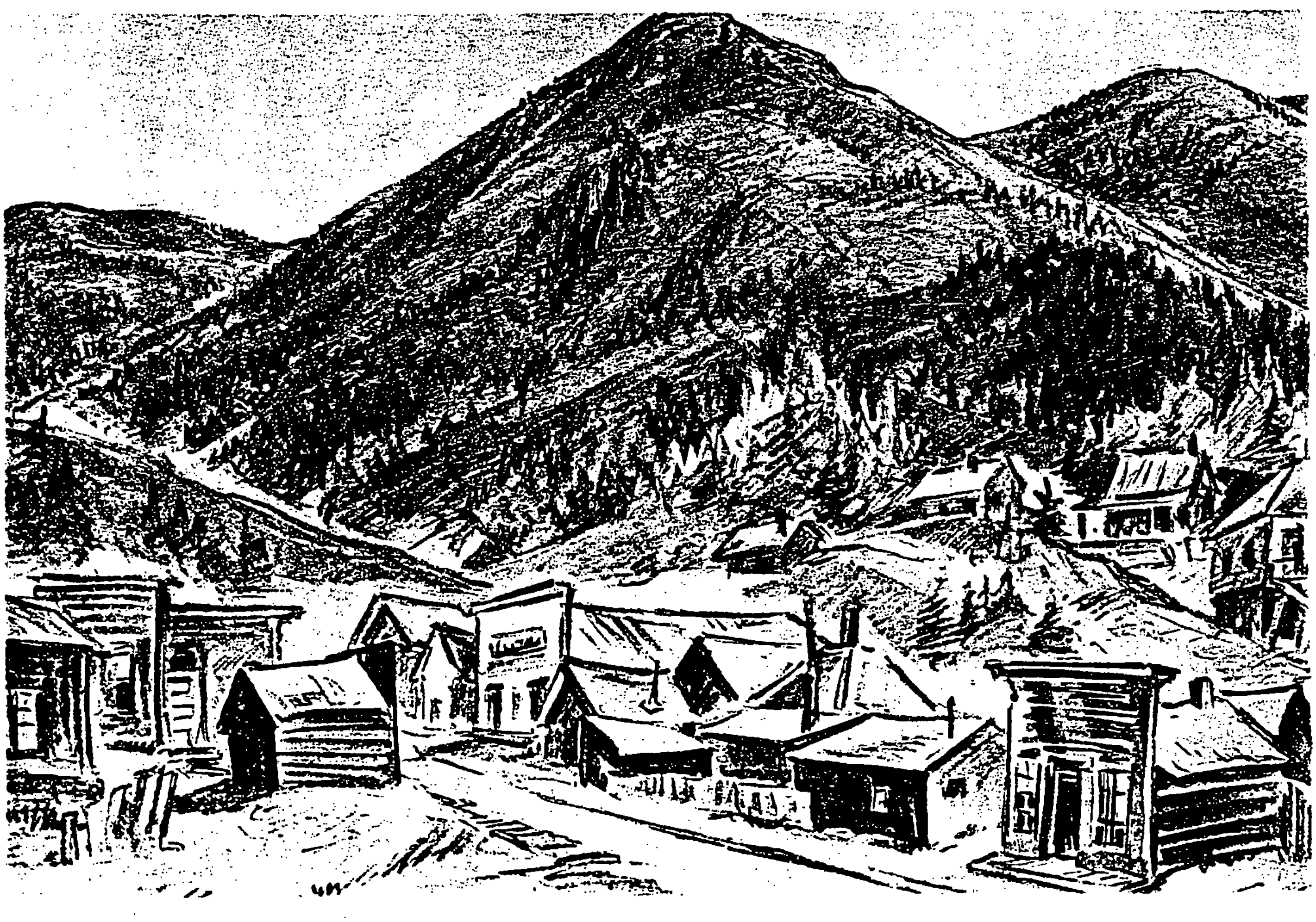
The Belt river rushes through town. . . . We feel confident that someday [Neihart] will eclipse Leadville, Virginia City, (Nev.) Butte or any mining camp of recent days.

Husbandman
The River Press, May 20, 1885



APPROACH TO NEIHART

NEIHART



The *River Press* urged more trade between Fort Benton and Neihart:

We hope our citizens will take some prompt action in regard to opening a road from Fort Benton to this most promising mining camp in the territory. Each day's delay is a positive loss of business to the city, and a loss of transportation to the river and a loss to the camp.

The citizens of Neihart and the entire length of Belt creek will perform their portion of work and with the aid of a few hundred dollars from Fort Benton, the road can be an accomplished fact inside of three months.

The River Press, April 22, 1885

From the start, the mines made the camp. Throughout 1884, the Queen, Galt, Belle, and Mountain Chief began shipping ore to Omaha; net returns averaging $200.00 a ton, after "deducting $100 a ton for freight and treatment." Carpenter and Aldrich, the discoverers of properties in the Belt Park district, developed the Dubuque and Mammoth No. 1 and No. 2 at the same time.

The whole camp waited impatiently for the completion of the Hudson Mining Company's $200,000 concentrator and smelter and mile-long flume, which were completed between 1885 and 1886. The company had bought the Mountain Chief group on Carpenter Creek in 1884 for $18,000 and spent $10,000 more in developing the mine. Around this property, two miles below Neihart, the camp of Jericho sprang up — an industrial village which was regarded not only as a suburb, but also as the inevitable site of future smelters.

In April, 1885, the St. Julian, Minnehaha, Maud S., Montana Belle, and Dickens properties — a group of mines on the west side of Baldy, about one-third of a mile from Neihart — were acquired by Colonel C. A. Broadwater, Longmaid, J. J. Hill, and others and worked by a crew of seventy-five men. As the rich surface became exhausted, refractory material hard to concentrate was encountered and, halted by this metallurgical problem, the promoters suspended work, according to some, "just when success was within easy reach."

The districts' other mines were experiencing the same setbacks, and, as property after property ceased to operate, most of the miners left to try their luck in more active camps. Between 1887 and 1890, Neihart was nearly deserted. Recalling this period of recession, a reporter for the *Great Falls Tribune* wrote:

This was a time that tried men's nerve and fortitude for often the cabins contained only flour, beans and bacon, and at one time it is said that in Neihart there was not a candle in the camp for more than a week.

Deserted cabins without doors or windows, stared on every hand, the advent of a stranger was a matter for village comment, saloons were practically deserted and the one general store was bearing a heavy burden of "jaw bone."

Great Falls Tribune, January 3, 1891

But mining camps have amazing recuperative powers, and the news, in 1890, that a railroad to Neihart was assured, brought the camp back to life. People flocked in, mines changed hands or were bonded to investors, and new buildings rose on vacant lots between weathered shacks, dating from the eighties.

Building Boom

On every hand may be heard the ringing of hammers and the merry whistle of the masons laying stone on stone and fast bringing great business blocks from the ground up.

Great Falls Tribune, June 19, 1891

The railroad, which was a branch of the Montana Central (later a part of the Great Northern), was completed to within fifteen miles of Neihart by June, 1891. The line was finished on November 15, and two days later, Neihart held a welcoming celebration. A special excursion train, filled with passengers from Great Falls and Helena, left Great Falls at 8 a.m. and reached the mining camp about noon. The visitors were met by the Neihart Free Coinage Brass Band, but as the temperature registered below zero, the musicians were unable to play. Blasts of powder and dynamite set off on the mountainside provided noisy salutes and prefaced the carefully prepared program, in which a silver spike, cast from Queen of the Hills ore, was driven symbolically to complete the road. Because of the weather, the rest of the program was shortened and each visitor was hastily given a souvenir badge, which entitled him to lunch at any hotel dining room or restaurant in the town.

The return trip was boisterous, for many of the passengers had found refreshment to their liking in Neihart's many saloons. Jew Jake, a gambler, was particularly pugnacious and resented the attempts of George Treat, the marshal of Great Falls, to quiet him down.

"Cut it out, Jake," said Treat. "There are women and kids on this train, and we don't want to make any trouble for them."

"You're not man enough to make me cut it out," said Jake, and shot his hand back to his gun pocket.

Treat looked him in the eye without moving.

"I'll settle with you when we get off the train," he said. Jake made the mistake of believing that he had Treat bluffed and he kept calling him names till the train approached the station. . . . People sensed tragedy ahead as they piled off the coach.

Treat waited in the car till all the crowd were on the ground and had time to get away. Through the window he saw Jew Jake standing on the platform waiting for him. As Marshal Treat stepped to the platform Jake began to shoot. His aim was wild and one bullet struck a bystander, injuring him. But when Treat's forty-five went into action no bullets were wasted. The lead flew at Jake in a stream and in a few minutes he lay on the platform with one of his legs practically shot off. It was amputated at the hospital a little later.

Jew Jake later ran a saloon at Landusky and often used a Winchester for a crutch.

Fairfield Times, February 18 ,1918

With the revival of mining and the advent of the railroad, Neihart emerged from a "Deserted Village to a Bustling Mining Camp." The Belt Mountain Miner's Union, organized May 10, 1890, "bolstered up the standard of wages," and provided a library for its members "second to none in this part of Montana." Several hotels were built, the Neihart and Manitoba on Main Street and the National on Granite Street, but all three were eclipsed by the Frisco Hotel, George Roehl, proprietor, which opened October 1, 1890, with "water on every floor and electric lights" in each of its sixty rooms. On December 4, 1890, the *Neihart Herald* was born, edited by J. C. Wilson and A. L. Crosson.

Several secret societies were organized during this period: the Belt Mountain Lodge, No. 18 A. O. U. W. in October, 1891, with sixty-four members; Banner Lodge No. 49 I. O. O. F. on March 25, 1893, with twelve members; Local Assembly No. 864, K. of L., instituted in 1893 and reorganized as the Neihart Labor Union, with seventy-five members.

As soon as the Neihart Fire Department was established in 1891, the members gave a dance to raise funds for the buckets, ladders, and a bell. "The bell or pot as it might be more properly designated, was raised upon Henry Wilson's stable. Chas. Crawford was elected Chief." By 1893, a hose house had been built, 1,000 feet of hose and two hose carts purchased, and the volunteers divided into three companies — two hose and one hook and ladder. This caused rivalry between Hose No. 1 and Hose No. 2. "No public day is passed without a hose race for a keg of beer or some light refreshment. Co. No. 1 holds the belt

STORE, NEIHART

which No. 2 will certainly win in the next race." Yet four years later, civic interest in the fire department seems to have waned:

At a fire meeting held to organize a company, where was expected a majority, at least of Neihart's business men, only twelve were present to discuss plans or to do business. . . . Dick Brennan remarked that most of the citizens employed hoodlums and bums to watch their houses from fire while they sleep . . . and all were of the opinion that the public would take little interest in a fire company until the gulch is once burnt out from Jericho to Last Chance saloon.

Neihart Herald, February 5, 1897

The next week the *Herald* smugly reported the organization of a fire company.

Throughout 1891 development work in the several large mines readied them for steady production. Just as all seemed set, the price of silver tumbled and once more Neihart's boom collapsed. Fortunately for the camp, W. J. Clark and his associates purchased the Broadwater and Chamberlain properties for an estimated $165,000 and operated them steadily for two years, averaging a carload of ore a day. From this production, the company's net profits totaled $200,000-$300,000. The Benton and Big Seven mines also continued to work despite the low price of silver.

About 1908, Colonel Hubbard of Great Falls played a hunch which paid off. When Neihart's poplation dropped from several thousands to less than one hundred and property could be bought up for taxes, Hubbard bid for the townsite at a county sale and obtained thereby nearly 1,000 lots. Surveyors laid off the choicest sites, and within a year Hubbard sold enough to repay his investment and give him a margin of profit. When World War I broke out and the price of silver and lead increased, Neihart began to boom just as he had hoped. Since then, Neihart has had other revivals, the first between 1919 and 1929, when:

A crew of engineers and samplers, reported to be representing W. A. Clark interests of Butte, are making a survey of the Big 7 Silver-Lead mine near Neihart. . . .

Reports from Great Falls fix $325,000 as the price to be paid by the Clark interests if the deal is consummated.

Froid Tribune, April 3, 1925

The next was from 1935 to 1937 when several properties, including the Rochester, M. & I., Florence, and Silver Dyke, yielded zinc as well as silver-lead-gold ores. Total production for the district up to 1935 is estimated at $16,000,000, mostly from silver.

In 1945 Neihart received another blow when rail service was canceled between it and Great Falls after fifty-four years of operation. The last train, drawn by Engine No. 511, with engineer George Doros at the throttle, and George Montgomery as fireman, left Neihart on a Saturday in November. Its one coach was crowded with nostalgic passengers who had often taken it on excursions and picnics and on trips to the big city. Its departure marked the end of an era. But even without rail connections, Neihart is still a mining camp and also a summer resort.

Until recent years when forest fires destroyed timber at the lower end of the canyon and the beauty of the clear mountain-born stream flowing through it had been ruined by the tailings of the concentrator near its source, Neihart canyon was said to rival Switzerland for scenic beauty.

Froid Tribune, September 12, 1924

Belt Creek runs clearer than it did in 1924 and the hills are greener. Who knows when Neihart will have its next revival?

Just before we left Neihart, I consulted the map to see where the Yogo-Running Wolf District lay, for I knew it was in the mineral strip of the Little Belt Mountains. Everyone to whom I talked said it was impossible to reach from Neihart, although it lay directly east of the town, and that even from the Judith Valley, it was difficult to reach by car. Since its fame lay in its gem deposits rather than in gold or silver, I decided to scratch it from an already crowded itinerary, but to learn as much as I could about it.

YOGO

Across the mountains east of Neihart lies the Yogo District. All that was needed in the spring of 1879 to send hundreds of men stampeding to that portion of the Little Belt Mountains was a rumor that rich placers had been discovered in the alluvial gravels of Yogo Creek. Their concerted efforts produced miles of ditches and flumes and piles of gravel from which the elusive colors had been recovered. With tents and log houses strewn along the creek for fifteen miles, two embryo camps called Yogo City and Hoover City sprang up only a few hundred yards apart, each determined to become the metropolis of the gulch. While the excitement lasted, their peak population was reported as between 1,200 and 1,500. At the end of the first season the boom was over, for cleanups revealed so little gold that further work seemed useless and the disgruntled miners packed out as speedily as they had rushed in. By 1883, nearly everyone was gone; ten years later, only a dozen men remained in the vicinity.

Jake Hoover had a cattle ranch on the South Fork of the Judith River. He had come to the Judith Basin early in the 1870's and had taken part in the gold rush to Yogo Creek in 1879. In fact, he was made the first recorder of the district, and Hoover City was named for him. With prospecting in his blood, he spent his summers in the mountains and on one expedition he made an important discovery. There are at least two versions of his strike, but each ends identically. Jean Sutter relates that during 1894, Hoover and Frank Hobson, while gophering in the Little Belt Range, took refuge under a rocky ledge during a mountain storm. In a crevice they uncovered flake gold. Exploring the area more carefully, they sank "some forty holes between Yogo and Sage Creek divide," and then, confident that they had made a strike, interested S. S. Hobson in their discoveries, offering him a share in their claims in return for a much needed ditch to bring water to their ground. Hobson obtained the necessary money from Dr. J. A. Bouvet (Bovette, Bovett), a Chicagoan, and the doctor was included in the partnership. The ditch, which carried water from Yogo Creek to the benchlands east of Yogo Canyon, was completed in 1895 and cost $38,000. The partners could hardly wait for the cleanup, but when it was made, the gold totaled less than $1,000. This unexpected blow caused the gold operations to be dropped. To be sure, whenever the men cleaned their sluiceboxes, small blue pebbles were found caught in the riffles with the gold, but these were tossed out with the rest of the waste. Soon after this disappointment, Frank

Hobson went to Maine and while there told a friend, who was a teacher, about his mining experiences. She asked him to send her some specimens of gold ore to show to her pupils. Upon his return home, he packed some dust in a small box, as well as a few of the blue pebbles, and sent them to her. In her response, she said nothing about the gold but thanked him for the sapphires, which she had had appraised.

"What in hell is a sapphire?" asked Hobson. This was the first clue as to what the men had found.

The *Grass Mountain Review* (March 21, 1921) tells it differently. According to it, Hoover started alone on a long pack trip into the mountains to look for a lead that he had noticed years before. It was late afternoon when he crossed Yogo Creek, and since the weather was cold, he decided to spend the night in one of the old abandoned cabins. Before leaving in the morning, he could not resist washing some of the creek gravel. Since the first few pans revealed scarcely any colors, he was about to quit, when he noticed a few smooth blue pebbles in his pan. He tried again, only to find more of the transparent stones with each washing. His pack trip forgotten, he rode twenty miles to the S. S. Hobson ranch at Utica. Hobson and he were mining associates, and any strike that he made was developed with Hobson's money.

"What have I found?" asked Hoover, displaying the strange blue pebbles.

"They could be sapphires," Hobson replied. "I'm leaving for Helena. Let me take them along and show them to a jeweler." Upon his return he reported that, according to a Swiss gem cutter, the stones were high grade sapphires.

According to a third story, Mrs. James H. Connely of Brooks, Montana, believes that she found the first sapphire in the gulch:

> My husband and myself went to Yogo in 1880 with the first big stampede. There was a position as cook there for me at the time and I remember that was one of the reasons for going. A sawmill went into Yogo district in March of that year, being freighted in by P. W. McAdow and Ben Dexter. Mr. Connely worked at the sawmill.
>
> I found what I believe to be the first blue sapphire ever discovered in Montana. We were walking down the gulch and I saw the sapphire in the creek and picked it up. I looked at it and threw it away. Two or three years afterward a sheepherder found a sapphire and gave it to Jake Hoover and he in turn gave it to S. S. Hobson, who sent it to Helena.
>
> In April, 1881, we started for what is now Maiden.
>
> *Richland County Leader*, January 9, 1922

Jim (John) Ettien, a settler in the Judith Valley, was prospecting on a bench land east of Yogo Creek early in 1896 when he noticed in a limestone fissure a soft filling which resembled the outcrop of a vein. Close by were several gopher holes, dug in an almost straight line in the same soft earth. These also attracted his attention until he reasoned that the adjoining ground was too hard for the little animals to excavate. Ettien was looking for gold; so he filed two claims on the barren bench land, but his prospects yielded nothing but blue stones, which he didn't recognize as sapphires. (Later on, some of the best gems were picked from the fissure and the gopher holes he had discovered.) Hoover and Hobson were, at the time, working a placer claim nearby; for, by 1896, the two men and Dr. Bouvet had formed a partnership and were developing the mine which Hoover had located. Their engineer warned them not to run tailings on Ettien's claim for fear of a suit and urged them to buy up the ground if they could. The purchase price was $2,450. The men worked their sapphire mines until Dr. Bouvet died. Long before this, Hoover had sold his share of the property to Hobson and Matt Dunn for $5,000 and gone to Alaska.

In 1898 the New Mine Sapphire Syndicate, Inc., a company financed by English capital, operated the mines. This company worked their territory through open cuts and by hydraulicking the deposit from the sides of the hill. In 1901, the English company also sank a 250-foot shaft and ran drifts into the lead. The ore was hoisted to the surface and dumped on washing floors where it was left to weather and further disintegrate. This latter process took time — at least a year, sometimes four. The sapphires, held in chunks of hard clay, could not be recovered until the rock became pulverized. It was then washed in sluice boxes and the sapphires caught in the riffles. The larger stones were hand-sorted at the mine, but the most valuable stones were sent first to London and then to European centers for grading and cutting.

No attempt was made to find a mineral vein west of Jim Ettien's discoveries until in 1901, by accident, one showed up about three miles west of the English mine. An employee from the Burke sawmill, which stood at the mouth of Yogo Creek, left Utica one afternoon and started back to the mill. Perhaps he tried a shortcut; in any event, he got lost and spent the night on top of a hill. In the morning, to his surprise, he found himself lying on a sapphire vein, with several stones visible in the outcrop. His discovery was staked and recorded as the Lion lode on September 23, 1901. Early in January, 1902, Patrick T. Sweeney made a location on ground extending across Yogo Creek. John Burke and Sweeney worked these claims together, in a superficial way, by means of cuts from which they hauled the dirt to his sawmill and washed it.

The American Sapphire Company took over their holdings in 1904 and for ten years carried on extensive operations. The ore was handled in much the same way as at the English mine and then run through the company's mill, which was constructed in 1906. The American mine, as it was called, lay at the junction of Kelly Coulee and Yogo Canyon. Around it grew a company camp whose buildings lined the sides of the canyon, forming two streets which intersected at right angles. The mill and blacksmith shop stood opposite the mouth of the coulee, on the east wall of the canyon. Up Kelly Coulee was the "mess hall and a small private schoolhouse for the children of the president's sister, several houses . . . a recreation hall and a number of barns."

Interestingly enough, the American Sapphire Company introduced daylight saving time by setting the clocks one hour ahead, which gave the men long evenings in which to fish and pursue their individual hobbies. Any employee suspected of stealing gems, or caught with the stones, was immediately discharged and sent packing, on foot, to Utica, twelve miles away, the nearest point at which he could catch a stage and leave the district. The company sold the mine in 1914 to an English company which made no attempt to operate it.

Even during its most active years, the Yogo District was hard to reach. It was some distance from a railroad, and all supplies and ore had to be hauled over a wagon road between Utica and the mines. A horse trail led across the mountains to Neihart.

During the first stampede to the district, in 1879, a similar rush to Dry Wolf and Running Wolf Creeks, north of Yogo, took place, with prospectors staking hundreds of lode claims in anticipation of the silver and lead deposits they hoped to uncover. Sahinen, in his report (1935), mentions two shipments from the Mountain Side mine which "showed 59-90 oz. of silver and 10% lead and 20% zinc," and adds that a small amount of placer gold was recovered from the stream gravels of Running Wolf and Yogo Creeks. He concludes, "A few small mines at the head of Dry Wolf and Running Wolf have been productive,—the Woodhurst, Montana, Yankee Girl and Sir Walter Scott."

The sapphire mines were closed in 1929 and were not reopened due to litigation, which prevented Charles T. Gadsen, who remained as caretaker after the shutdown and organized the Yogo Sapphire Mining Company, from developing them. Since then, the properties have deteriorated and their buildings, ditches, and flumes have been badly damaged by vandals, animals, and weather. The cabins of Yogo and Hoover were long since carried off by homesteaders for use on the treeless plains of the Judith Basin. Six empty and dilapidated cabins are the sole survivors of a district from which between \$3,000,000 and \$4,000,000 worth of sapphires have been mined. The stones were sold for gems, as well as for use in scientific instruments, watches, clocks, and as bearings in meters. Sapphires from Yogo ranged in color from pale to royal blue, with first quality stones bringing \$6.00 a carat in London. According to the U. S. Geological Survey (1952), the Yogo deposit was the most important gem locality in the country.

In July, 1956:

> Sidwell and Commercial Uranium Mines, a Denver corporation, bought up 145,000 of 150,000 shares in the British syndicate . . . (which) stopped working its claims because of currency difficulties involving the pound sterling and double taxation by U.S. and Great Britain.
>
> *Great Falls Tribune*, July 11, 1956

Who knows what will happen next in the gulch?

COPPEROPOLIS

Three miles north of White Sulphur Springs, Highway No. 6 joins Highway No. 89. Had we driven east for several miles on Highway No. 6, and looked closely, we might have seen one cabin — all that remains of Copperopolis. In its early years, the place was primarily a stage station, about halfway between White Sulphur Springs and Martinsdale, but the discovery of copper veins in the area north of Castle Mountain, in 1866, by E. J. Hall and his partner, Hawkins, attracted attention to it as a mining center. These two men, who are credited with discovering the first copper ore in Montana, packed out five tons of the rich metal by jack train to the Missouri River, where it was shipped to Swansea, Wales, for smelting. Hall made a profit on his ore and held on to his claims, eventually selling them in 1900 for $1,800.

The discovery of copper brought prospectors to the region and customers to Elizabeth Scott's hotel and stage station. In July, 1884, Mary Holliday bought Scott's hotel for $2,000 and ran it successfully for a number of years, catering to miners and stockmen from the Judith Basin. During the eighties and nineties, little development work was done on the several properties that were located, and only small amounts of ore were shipped out; for hauling costs were exorbitant until a railroad was built into Martinsdale in 1896. Although John Blewitt's strike, in the nineties, uncovered rich ore, it was not until Marcus Daly bought up the copper prospects just before his death in 1900 that Copperopolis flourished.

With such backing, W. W. McDowell lost no time in locating a townsite and offering a lot to anyone who would build immediately. All was confusion, but before the end of October, twenty-five structures stood on land bordering what would become the two main business streets, although men with teams were still grading them. By the time that sewers were laid and sidewalks built, five and six-horse teams were hauling ore from the mines for shipment on the railroad.

Copperopolis, a company town to which the miners brought their families, was equipped with a general store, livery stable, blacksmith shop, barber shop, boardinghouse, restaurant, and bunkhouses. It was self-sufficient, and the men were expected to trade in its stores. On November 12, 1900, Daly died, but even without his vision and guidance, Copperopolis carried on for a time.

Two patented claims in the camp were the Northern Pacific, originally opened in 1867, and the Darling Fraction, located on the slopes north of the Musselshell River and northeast of the stage station. Other properties included the Copper Duke (also known as the Virginia), Ohio, Hecla, East Hecla, and Calumet. The deepest shaft was 550 feet; much of the ore, however, was recovered close to grass roots, some running as high as eighty per cent copper.

During the first nine months of big-scale operation, a quarter of a million dollars was recovered from the mines. No doubt this was a mere start, but the economic depression in Germany, in 1901, which cut copper exports in half, caused copper prices to fall. Under these circumstances, the mines were forced to close in 1903, and the miners and their families left camp. From then on except for two men — George Dinsmore and Jack Norris — Copperopolis, the boom town one-quarter of a mile from the highway, was deserted. These two, who hated each other, stayed for years in the empty settlement, each living his own life and avoiding meeting by going at different hours to the town spring. Occasionally leasers opened one or more of the old properties, but other than their brief explorations, the camp was quiet. When the "dry-landers" in the valley attempted to homestead the area in 1915, they tore down the buildings for lumber and hauled them away.

Copperopolis is a true ghost town, with pitted hillsides dotted with stained dumps. Some years ago, the Northern Pacific hoist was still standing and, below it, a log cabin on ground once occupied by the stage station. The site of the company town, now a swampy meadow, may be seen by looking through a gap in the hills to the south of the highway.

CASTLE

The hills and rolling lands around Castle Mountain were known only to a few cattle and sheep men until early in the 1880's. These open ranges and forested hillsides were fairly accessible; for wagon roads connected Livingston, on the south, with White Sulphur Springs, on the west, and with Martinsdale, on the east. Except for a few ranches, the land was untouched.

Hanson H. Barnes, a veteran miner who came around the Horn, was probably the first prospector to wander into the area. Having settled first at Diamond City, he moved on to White Sulphur Springs, where, by 1881, he was postmaster; but these duties did not prevent him from tramping over the mountains in search of ore. He found outcroppings in 1882, but did nothing about them, and it is generally conceded that his first real strike was made in 1884. Authorities differ as to whether his initial discovery was the Bluebell, near Robinson, or the Princess, near Castle. He also staked the Maverick, Alaska, and Bassom.

Early in 1883, F. Lafe Hensley, an experienced miner and assayer, went hunting in the valley of the Musselshell River, fifty miles below Castle Mountain. While on this trip, he found a small piece of carbonate iron float, and with a miner's compulsion, started searching for the lead from which it came, working his way up the Musselshell and following all its tributaries. For two years he prospected first one gulch and then another, until in June, 1885, he found the outcrop and staked the Yellowstone mine on a mountain near the present town of Castle. It was the following season before he had enough money to return to his claim and locate it, and when he did start back to the hills, his three brothers, Ike, Joe, and John accompanied him. The Yellowstone, which became one of the largest producers in the district, was situated high on a mountain spur between Hensley and Hamilton Creeks, at 7,200 feet elevation. The brothers worked it until the spring of 1887, when they bonded it to Messrs. Crounse, Hauser and others for $75,000. When fully developed, the mine ranked third in the district.

The Hensleys were fortunate in opening other mines — the Morning Star, Belle of the Castles, Lamar, and Chollar in 1885, and in bonding them, in 1887, to Messrs. Kindred and others for $40,000. In 1886, they discovered the Great Western and American, and in 1887, the California, Iron Chief, Golden, and Gem.

At about the same time, Lafe and Ike Hensley discovered, close to their Yellowstone lead, the Cumberland, which became the bonanza of the camp, producing, before its final shutdown in 1894, between $750,000 and $1,000,000 of ore. This mine, situated in the canyon, three-quarters of a mile above Castle, the brothers worked during the winter of 1886. In the spring they bonded it to Messrs. J. R. King and Thomas Ash of Billings and Helena, for $50,000. Word of its huge ore body attracted other men to the region, and many more properties were opened.

During the winter of 1885-1886, George K. Robertson found samples of lead and silver float near Yellowstone Ridge, while prospecting with Lafe Hensley. When specimens were sent to Riley Lewis and C. F. Chapin, assayers at Wickes, the men not only returned a favorable report on the ore, but also hurried to the mountainside to look at the prospect.

Lewis and Chapin and George H. Higgins were successful that same year in locating the Great Eastern and in bonding it, in 1887, to Messrs. Woolsten and Hamilton of Helena, for $60,000. The Great Eastern, which became the second biggest producer in the camp, was also on Yellowstone Ridge. By 1888, the Castle Mountain Mining & Smelting Company had been organized at Helena to operate the mine with a capital stock totaling $1,000,000. In time, the American, Chollar, Potosi, and Great Western properties also came under the jurisdiction of the Castle Mining Company.

The Hidden Treasure, discovered in 1887 by Dunn and Donovan, was bonded to Hauser & Company for $40,000; the Princess, owned by H. H. Barnes, was bonded for $10,000. Most of the 1,500 mining claims were discovered between 1886 and 1890.

ROBINSON and BLACKHAWK

While this rush was going on, certain of the prospectors pushed several miles up the canyon to search for lodes. At two points, small camps developed — Robinson, four miles beyond Castle, and Blackhawk, seven miles distant from it.

George P. Robinson, for whom the camp was named, and who was one of the first prospectors to reach the district, located the Top (later called the Eclipse) in 1885. Paul Grande (Grade or Grandy) and N. A. Nelson, who ran the Pioneer House in the new camp, found the Silver Star and North Star in 1887. The camp never exceeded 300 in population.

Smith's Camp, soon renamed Blackhawk, was three miles beyond Robinson. The Smith brothers were the sole owners of the Blackhawk mine, as well as part-owners of virtually every other mine in the camp. These included the Alice, Altha, Legal Tender, Little Casino, and Iron Chief.

In 1891, the town had a building boom and its population reached 200. The following year the Castle newspaper devoted a column to "News from Blackhawk."

There was a pleasant surprise party at the home of E. S. Pardee one night last week; dancing was kept up till after 3 a.m. . . . a scarcity of men was the only thing that prevented the party from being a complete success.

Castle Reporter, October 15, 1892

Blackhawk's prosperity, however, was short-lived, even though low-grade ore and small quantities of zinc and lead were shipped after the camp declined.

CASTLE (Continued)

As a result of all these discoveries, a town named Castle, because of the turreted peaks above it, came into existence in April, 1887. Lafe Hensley and George H. Higgins built the first cabin in June and were joined before Christmas by 200 other settlers who had gathered in this embryo camp at the southern end of the mining district, at the foot of the mountains. Its buildings straggled along Allabaugh Creek, named for Sam Allabaugh, a stage driver and prospector, following the rough wagon road that cut through the narrow gulch to the mines. As Castle grew, the high mountains to the north prevented expansion in that direction, so it sprawled over the rolling meadowland south of the gorge.

Prior to the stampede, James Keen and John N. Reynolds of Townsend drove to Castle Mountain in a buggy and camped where the town now stands. While there, Reynolds said, "I'm going to own a town lot in this place." Cutting and labeling location stakes, he drove them into the ground. Two years later, when he was making the town survey, he ran across his markers in the middle of what was designated as Main Street. Worse still, his claim had been jumped, although, according to another version of the story, he sold the lot to Ash & King for $25.00, only to learn that some time later, the same ground brought $5,000.

The Castle Land Company platted eighty acres for the townsite and, according to a news item, "so popular is this beautiful tract that during the first sixty days, when it was placed on the market, over $100,000 worth of lots were sold. Water from Allabaugh Creek is pure and wholesome."

Dr. J. P. Rhoads and two of the Hensley brothers opened the first store, which handled merchandise. Before long, there were "80 dwellings, a score of business houses . . . a hotel, post office . . . resturants, lodging houses . . . carpenters, blacksmiths, wagon shops and two sawmills."

By the time the camp population reached several hundred, lot jumping was a common practice. A man, upon reaching his property some morning, would find it occupied by rough, armed men who drove him off and told him the ground had changed hands during the night. To stop this, a Vigilance Committee, composed of most of the solid citizens, was formed, headed by postmaster H. H. Barnes. The toughs hung out in a log cabin on a slope of the gulch. The Vigilantes rushed it one night, but a guard, stationed by the jumpers, warned the men of the posse's approach, and one of the desperados called out that the first man at the door would be shot down. The Vigilantes seized a log from a woodpile and battered at the door. After the first blow, there was a commotion at a

CASTLE TOWNSITE

side window, and when the attackers entered the cabin, it was empty. The toughs were gone for good.

Bill Gay and Gross, his brother-in-law, caused considerable excitement in the town during 1890. Gay and his brother Al had taken part in the Black Hills gold rush — Gayville is named for them — but after Bill killed a young fellow and was sentenced to the penitentiary, he spent all his money getting his term reduced to three years. When he and his quarter-breed daughter arrived in Castle, he was stone broke. The G. K. Robertsons were good to them, giving Gay odd jobs and befriending the girl.

Gay discovered a coal lead at the edge of town and dug a twenty-five foot shaft. One day he found a Mr. Benson, the editor of the newspaper and owner of a print shop, not only on his ground, but also in the shaft, having jumped the mine. Gay ran off Benson's hoist man and threw the windlass rope down the shaft. Benson's shouts soon brought help, but as a result of this incident, a lawsuit developed over the mine. When the case was tried in Helena, fifty witnesses from Castle were summoned to appear. The bi-partisan group drove to the court in "buckboards and buggies," stopping for lunch at a stage station east of Townsend. While there, the opposing teams of witnesses got into a fight and reached Helena with black eyes and bloody knuckles.

After the trial was over, Gay, assisted by Gross, took revenge by burning Benson's print shop and setting fire to other buildings in Castle. The pair were seen behind Fowlie's saloon just as they were about to set it afire, but in the dark, they made their escape. Since Gross was also suspected of several burglaries, sheriff William Rader of White Sulphur Springs, accompanied by a group of deputized citizens from Castle, followed the man to his cabin in the hills. When the posse reached the stronghold that was built against a sheer cliff and protected by breastworks, Gross called out that he would shoot to kill any man who tried to enter. Sheriff Rader replied that they only wanted to search the place. Gross then came out and was handcuffed while the deputies rooted through the shack but found nothing. Since the arson charge was not conclusive, he was released and promptly left Castle. A second visit to the cabin by the sheriff revealed a cache of stolen goods under the floor. Again a posse set out to capture Gross, who, by then, had joined Gay somewhere in the nearby hills. When found, the two were "forted up," and in the ensuing gunfight, sheriff Rader was killed by Gross. In the subsequent manhunt, the two were spotted in a thicket of willows on the bank of the Musselshell River. There, Gross killed Jim Mackay and aimed at Robertson, but Gay, remembering the blacksmith's kindnesses to him, threatened to shoot Gross if he killed his friend. In the general melee, the two criminals escaped.

Castle reached its peak in 1891, the year it was incorporated. At its height, it contained nine stores, one bank, two barber shops, two butcher shops, two livery barns, two hotels, a photo gallery, dancehall, church, $5,000 schoolhouse, jail, fourteen saloons, as well as a justice of the peace, a deputy sheriff, and a brass band. Most of its development was with home capital from the farms and ranches in the vicinity. The camp was supplied with milk from More Brothers' dairy and with butter from Lincoln's and Potter's ranches. "Two-hundred and fifty goats were kept at Hill's ranch, the dinner station between Castle and White Sulphur Springs." Three four-horse stage lines provided daily service between Castle and Martinsdale, White Sulphur Springs, Townsend, and Livingston. So great was the traffic that Castle's streets were jammed with freight wagons and bull teams hauling in mining machinery and coke for the smelters. Any delay in delivery threw the town off balance.

During its brief life, Castle was furnished with four newspapers. The *News* appeared in 1888, followed by the *Reporter* in 1889. Next came the *Tribune*, and last the *Whole Truth*, which published during the nineties.

Congregational church services were held regularly at the Odd Fellows' Hall twice on Sundays, under the direction of Reverend Alice Barnes. Mrs. Barnes also held a Bible Study class at which "attendance was not small." As a licensed Congregational minister, she preached at Castle and later at other towns. The Methodists also met in the Odd Fellows' Hall, where they heard Reverend John Hoskins of White Sulphur Springs preach. St. Andrew's Episcopal Church met the first and fourth Sundays at 11 a.m. and 7:30 p.m. in Sharp's Hall with the Reverend Charles H. Reinsberg conducting services. The Presbyterians also held services and were hoping to build, but as far as I know, did not realize their ambition.

Besides the church services, there was the W. C. T. U. This organization met the first and third Saturdays of each month and had a regular column in the newspaper "edited by the Local Union 'For God and Home and Native Land.'" In addition, Castle was not lacking in secret societies, to which many of the citizens belonged. The Castle Mountain Miners' Union was considered the "strongest order existing" in the camp. Other organizations included Carbonate Lodge No. 39 I. O. O. F.; Loyal Lodge No. 27, K. of P.; and A. O. U. W.

With its mines active during 1892, Castle continued to thrive. A few topics of local interest that appeared in the paper show what the people were doing:

The flag purchased for the school last summer now floats over the schoolhouse daily. The Republicans of Castle will hold a primary tonight at 8 o'clock in the room under the Castle Mercantile Company's store, formerly occupied by Reed & Scott's drug store, to nominate two candidates for justice of the peace, and two candidates for constable.

Castle Reporter, October 8, 1892

Some fifteen or twenty of the town people have organized a coasting club for recreation and pleasure, the coming winter. The "Flexible Flyer," a new kind of sled, will be used.

Castle Reporter, November 5, 1892

The ranchmen are not bringing in vegetables enough to supply the demand here. A good market can be found here for potatoes, turnips and cabbages.

Castle Reporter, November 12, 1892

Grand Leap Year Ball

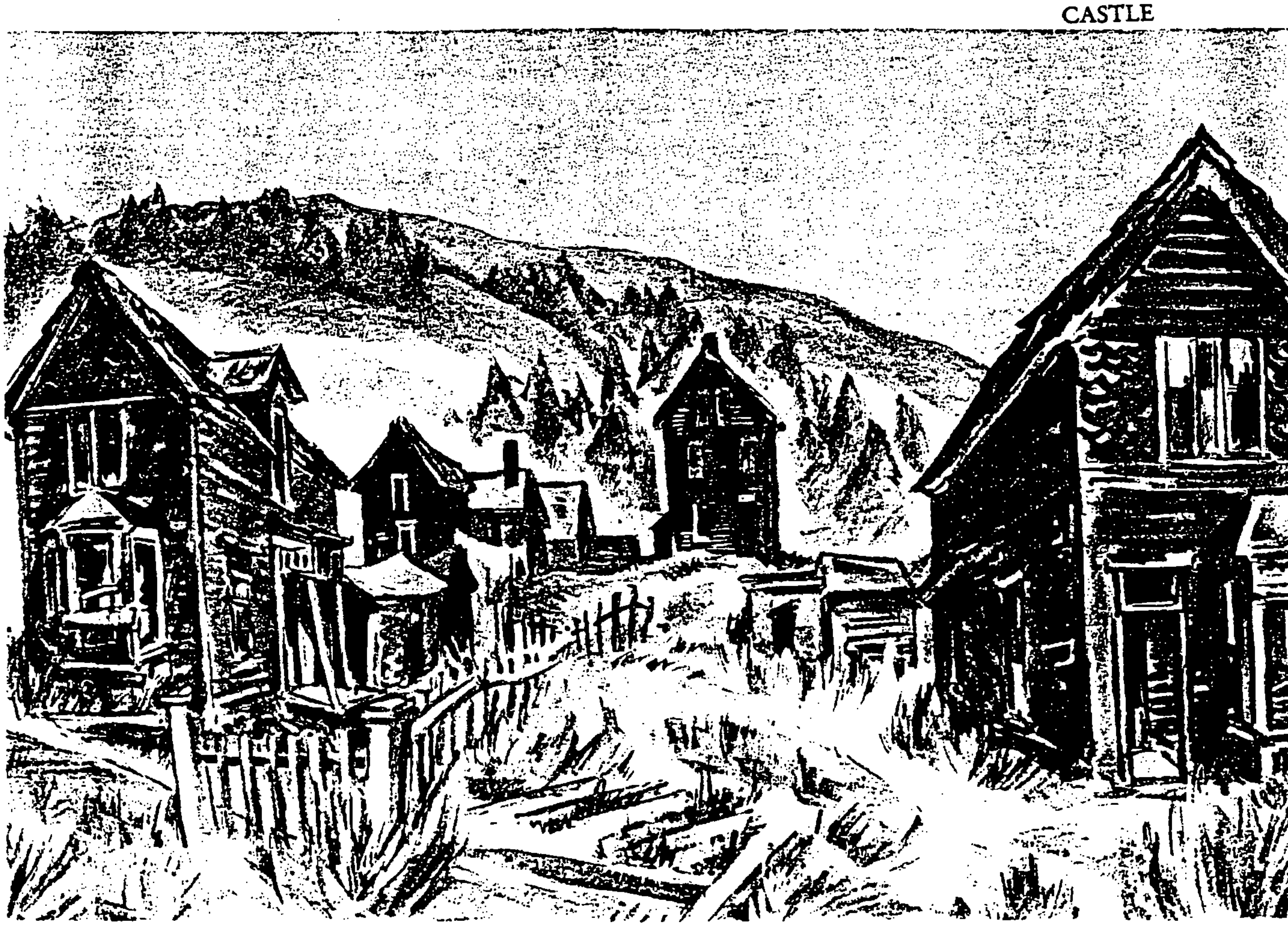
The ladies of Castle did the gallant this week and gave a grand ball at Odd Fellows' Hall. About forty couples were in attendance and all had a nice time. The girls made all the arrangements, paid the bills, etc. and every one agreed that they made things hum as they usually do when they try.

Castle Reporter, December 3, 1892

The town seems to have been concerned with the importance of fire protection, for on

EMPTY STORE, CASTLE

CASTLE



January 21, 1893, the *Reporter* stated that

> The fire boys were supplied this week with two heavy grappling hooks, chains and ropes, and a half dozen axes. These with the long ladders and 24 fire buckets puts them in pretty good shape to fight fires.

The winter of 1893 seems to have been unusually severe for

> A number of frostbitten ears and noses are the result of the present cold snap. At 2 p.m. Monday the thermometer registered 11 above zero; two hours later it was 11 below; sometime Monday night 41 below; at 8 a.m. Tuesday 39 below; at noon 30 below. About 18 inches of snow has fallen which is somewhat drifted.
>
> *Castle Reporter*, February 4, 1893

> A number of ice houses in Castle are being filled this week. The ice is about 12 inches thick and of good quality.
>
> A. R. Frame shoveled his way through the snow from Robinson one day this week on his way to Lucas' ranch from which place he is hauling hay.
>
> *Castle Reporter*, February 11, 1893

Castle's three smelters, which were built between 1889 and 1891, were kept busy refining the district's ore. The Cumberland and Hensley plants produced, in 1889, \$16,550 in gold and \$36,355 in silver. Bars of bullion, weighing 100 pounds, were hauled by ox-teams to Livingston, to the railroad. Freight teams, consisting of 6-8 head of horses or mules, also pulled ore wagons with unusually heavy loads, for the trip was all downgrade. Each year the output of the Cumberland mine increased until, during 1890, it produced 500,000 pounds of argentiferous lead and over 20,000 ounces of silver; by 1891, it was the largest single producer of lead ore in the state.

In 1892, however, the output fell to 300,000 pounds of silver, and jittery stockholders of the Cumberland Mining & Smelting Company became dissatisfied and suspicious of each other. When J. Kennedy Tod of New York City obtained control of the property, he arranged for W. P. Parsons, a mining expert, to investigate the mine and its reserves. After considerable expenditure of funds and further exploration, operations were suspended early in 1893.

The district needed a railroad to move its ore and cut shipping costs and, had it not been for the financial panic of 1893, a road would undoubtedly have been laid into Castle by that date. When it did not materialize, the Cumberland and other properties closed to await its arrival.

With the mines inactive, the miners melted away. The Cumberland boardinghouse, which had served 135 meals on the last night, served six men three days later, and these were the crew kept by the owners to dismantle the machinery. The last group to operate the mine were Len Lewis, B. R. Sherman, and Charles E. Severance, who formed a stock company and worked the Cumberland until 1894.

Even after the slump, some \$500,000 of ore was shipped out, work continuing as long as the mines showed a profit. The few families that remained — about twenty in all — made a living by "pecking around and raising small crops."

The demand for a railroad was not new. Ever since the town of Castle had been built, the people had been clamoring for one.

Richard Austin Harlow, a promoter of vision and shrewd business sense, together with a knowledge of human nature, was aware of the people's need and set out to satisfy it. During the summer of 1890, he first conceived of building such a road. The Cumberland smelter had already reduced 6,000 tons of silver-lead bullion from its great mine, but had not attempted to ship the ore; for it was too low-grade to warrant the cost of a long haul. Conferences with citizens of Helena, Livingston, and Bozeman resulted in offers of \$250,000 in money and real estate as bonuses to anyone who would build a road to the mines. Three companies were formed, but Harlow's was the only one to progress beyond the "paper stage." Although the Montana Railroad, which he built, reached Castle too late to save the camp, it provided a link between the Missouri River and the Judith Basin and, in time, paid off. The road was called the "Jaw Bone" because of Harlow's reputation of cementing a deal with persuasive talk instead of funds, yet, as he explained more than once, of the \$2,950,000 invested in it, only 3½% of the capital was covered by notes held by the various contractors.

Mrs. William T. Hart, of Harlowtown, writes of her interview with Richard Harlow in the *Richland County Leader* of January 9, 1922, and tells the story in his own words. Excerpts from her article are included in the following description.

During the summer of 1890, Harlow got in touch with J. P. Whitney, a friend from New Jersey who had some money to invest. Harlow interested him in the project, but Whitney's loan was only enough to start things moving. Just as work got underway, the panic of 1893 struck and Helena's promised support was withdrawn. With many men out of work, Harlow went into Helena's saloons and put the following proposition to any laborer who wanted work, saying, "If you'll work on my Montana Railroad grade between here and Canyon Ferry, I'll provide you with board, work clothes, shoes, and tobacco. Anything due you over that amount I'll pay in warrants, redeemable as soon as the grade is completed." The grade was built, but by the time it reached Canyon Ferry, Harlow's $25,000 capital was all spent. A hurried trip east failed to raise additional funds. This and other delays prevented further construction until May, 1895.

The right of way as planned ran from Lombard, on the Missouri River (south of Toston), up Sixteen-mile Creek, past Ringling to a point near Lennep, and thence up Allabaugh Creek to Castle, a total distance of sixty miles.

Work began and we thought our troubles were over. . . . We had a frightful time getting supplies up Sixteen-mile creek. A team and wagon had to travel sixty miles to get from the lower to the upper end of a box canyon which was scarcely half-a-mile long. A four-horse team with oats was sent to a camp from Toston and landed without a pound of oats in the wagon. It was caught in a snowstorm and the driver had to feed all the oats to the horses. The owners of little ranches we crossed held us up with shotguns. Ranchmen hesitated to sell us supplies, fearing they wouldn't get their money.

The line was finally built to Summit, with a branch completed in the fall of 1897 to Leadboro, two miles below Castle.

The day before Thanksgiving the last construction train left Leadboro for Lombard, loaded with passengers. It was caught in a snowstorm at Dorsey and lay there seventy-two hours without fuel or supplies. We finally got the train through without serious damage to the passengers.

With the completion of the railroad, the contracted 7,000 tons of ore from the Cumberland smelter were delivered to the American Smelting & Refining Company's plant in East Helena.

All during construction, the price of silver and lead was steadily declining. When the ore was finally delivered, both commodities were at the lowest point reached for years. Lead was 2½ cents and silver down in the forties. We got something like $78,000 for the ore. But our road was finished.

In the spring of 1898, an early thaw flooded Sixteen-mile Creek and washed out the roadbed so that it had to be completely rebuilt. By the time trains were running, traffic began to taper off. The only way to capitalize on what had been accomplished was to build a twenty-four mile extension east to Martinsdale. Next, an extension to Harlowtown was constructed with assistance from the Northern Pacific Railroad. The final lap to Lewistown was begun in 1902 and completed in 1903. "This extension," said Mr. Harlow, "justified the expense."

Now that the Northern Pacific was interested in the road, an official told Harlow that

the company was issuing a new folder and wanted to put our train table in it. He needed to know the name of towns and their distance from Lombard. There were no towns on the line, so I made up some, and strangely a number are on the map today. I was put to it for names. . . . There were two ladies visiting (us) named Fan and Lulu. On the road you will see the name Fanalulu, just below the town of Ringling.

Some years later, the "Jaw Bone" was sold to the Milwaukee & St. Paul Railroad. Harlow paid all his debts before he died and redeemed every warrant as soon as he sold out to the Milwaukee. Although the new owner tore up the road, it retained the route through Sixteen-mile Canyon to Lombard. The closest to Castle that the main line of the Milwaukee runs is through Lennep.

As the town quieted down, the residents made every effort to boost the morale to wait out the lull in production that they believed was temporary. To pass the time, a variety of entertainments were planned:

Free Reading Room

We desire to call the attention to the reading room. There are some things on our table that the readers of Castle cannot afford to pass by. There is an article in the March number of the Ladies Home Journal 'A Day with the President at his Desk' by the Hon. Benjamin Harrison, that is well worth reading. . . . Ladies are welcome in the afternoon.

J. A. Smith — Pastor

The Whole Truth, March 27, 1897

Mr. & Mrs. Jas. J. Fisher had a phonographic party at their residence Monday evening and invited a number of their young friends. . . . The guests were regaled by listening to the dulcet and melodious strains of the phonograph.

The Whole Truth, October 9, 1897

A Grand Success

The pop-corn festival on Friday evening was a grand success. . . . This was the first of a series of festivals in this city under the auspices of the ladies of the

Missionary Society. . . . Net proceeds . . . were the handsome sum of $25.00.

The Whole Truth, January 29, 1898

War hysteria and sentimentality mark this reference to the

Gallant Castle Boys in Blue

Harry McKee, Roy Sherman and Nug Corduro the gallant and brave boys of Castle who enlisted as volunteers in the First Montana regiment to fight the vile Spanish are by this time clothed in their blue uniforms. . . . Now boys, may God bless every one of you, for your cause is just, and after the war is over and the smoke of battle clears away, may you all return home with well earned honors to receive homage and ovation by friends and a kiss of hearty welcome and blessing by fond and loving parents.

The Whole Truth, May 21, 1898

By 1927, most of the abandoned mining claims were sold at a county tax sale to J. F. Brophy of Red Lodge. By 1936, only two men remained in Castle, "Mayor" Joseph Hooker Kidd and constable Joseph Martino. That winter the snow lay four feet on the level and in places piled up in forty-foot drifts. This isolated the elderly residents until their provisions got so low that Kidd, who was seventy-five, took his team and cutter and set out for Lennep, eight miles away. He made but three miles the first day and spent the night at a sheep camp. The next day he got to Lennep, stocked up on food, and with difficulty, reached a ranch by nightfall. Leaving early in the morning, he "shoveled snow and fought drifts all day." When within a mile of Castle, his exhausted team gave out. Turning the animals loose, he covered the rest of the way on foot. At nine o'clock that night, he reached Martino's place, drank some hot coffee, and started for his cabin, 500 yards away. Martino watched him go and held a lantern to light his way. Before Kidd reached his door, he collapsed, and when Martino reached him, he was dead. Martino was seventy years of age and too frail to move the body; so the best he could do was cover it with a blanket. Next day he skied to the sheep camp and told the herder what had happened. Three days later, the sheriff and coroner skied over from White Sulphur Springs and dragged Kidd's body out on a toboggan.

On the afternoon in 1955 when we drove south from Neihart, over King's Hill, a pass through the Little Belt Mountains, and dropped down into White Sulphur Springs, we debated whether to stay there and start for Castle in the morning, or to try to reach it before sunset.

"Let's start right now," said Francis, "and if we can't make it, we can go on to Helena." After we left Highway No. 89, some fifteen miles south of White Sulphur Springs, we were on a graded road. From it, the map showed two approaches to Castle. We found the first, an unmarked trail that took us across the Milwaukee tracks, through a gate and deposited us, after a mile's drive, in a ranchyard. Since no one was about from whom to inquire directions, we returned to the highway and drove east to Lennep, a drab little village consisting of one store, which was closed, a church, and three or four houses and sheds near a thicket of willows along the Musselshell River. By now it was late afternoon, and dark clouds hung over the mountains where Castle lay. As we left Lennep, a car, driven by a young ranch boy, came along, and we asked if it was going to rain.

"Yep," he replied. "The Castle road is gumbo when it's wet, but it's only seven miles." We drove on for a mile, watching the clouds. Where the road split, the Castle fork was deep, soft dirt, hard to manage even while dry. As soon as we could turn, we hurried back to Lennep and drove west over the Big Belt Mountains to Townsend, and on to Helena.

Our second attempt to reach Castle, in 1956, was successful. This time we left Harlowton early in the morning and drove to Martinsdale, where we stopped to ask directions. A truck pulled up ahead of us and eight men got out. They assured Francis that we could get to Castle even though the road wasn't kept up; for some boys were up there hunting uranium and they'd taken machinery in over it. With that, they disappeared into a tavern for a morning beer.

From Martinsdale, we drove west through ranch country, close to the Musselshell River and the Milwaukee railroad tracks. Before we knew it, there were the familiar buildings of Lennep in front of us, and, leaving the highway, we started for the mining camp.

The road beyond the fork was even worse than it had been before, and Francis drove carefully, straddling ruts, and measuring the width of a culvert which served as a bridge over a draw from whose surface dirt and boards were missing. After scraping between clusters of alders and willows, we crossed Allabaugh Creek on a few rattling planks and pulled up the bank to rejoin the good road, just beyond a fine ranch. The rest of the way was relatively easy, for the road had been dragged as far as a second ranch, which was only a mile from the Castle townsite.

At the end of our eight-mile climb, we saw buildings dotting the hillsides on both sides of the creek. Most of the houses were in ruins, although a few two-story frame residences looked sturdy enough, even though their windows and doors were missing. The sides of the road were lined with bushes which hid many foundations where business houses once stood. In some the whole cellar was filled with rotting debris and vigorous young saplings. In one lay an old trunk. Which broken walls, I wondered, had supported the Hensley-Rhoads building with its leaded glass windows, and where had James M. Addle and L. Peavy, Castle's two attorneys, had their offices? Which foundations marked the sites of the ten licensed saloons and seven brothels? When had the two-story schoolhouse, with its cupola and bell, been razed? Only from photographs had I any idea at which end of town it stood.

To investigate the camp more thoroughly, we left the car and wandered up and down the grass-grown but discernible streets. Which of the two frame sentinels with their bay windows and papered walls had belonged to Warren C. King, and which to Mrs. Smith? Just beyond them was a one-story house hidden among aspen and cedar trees. This, I had been told, was the home of Isaac M. Hensley, one of the four brothers who opened the Cumberland and other important mines.

The town was empty, but through the high thin air we could hear a gasoline engine and the sound of hammering. The noises must have been from the camp of the uranium boys.

On the way back to Lennep, I tried unsuccessfully to locate the site of the charcoal camp below Castle that was maintained by Italian wood burners as long as the smelters operated. When we reached the big ranch, we took the better of the two roads — the one which ran between its many sheds and buildings and through its barnyard. As we neared Lennep, we saw, across the creek, a new low-slung car rocking from side to side as it crawled over the miserable trail we had taken earlier in the day.

Reference No. 23

Montana Department of

Environmental Quality

MEMO

To: Crystal Roberts

From: Judy Reese Judy Reese

Date: September 27, 2000

Subject: Montana Department of State Lands
Abandoned Mine Reclamation Bureau
Site Inventory

According to Ben Quinones of the Abandoned Mine Reclamation Bureau, the mine waste and tailings volume estimates were made using a hip chain measuring devise and field estimates. Ben worked with the Bureau at the time the inventory was completed.

Reference No. 24

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU

ABANDONED HARDROCK MINE PRIORITY SITES 1995 SUMMARY REPORT

Prepared For:

Montana Department of State Lands
Abandoned Mine Reclamation Bureau
1625 Eleventh Avenue
Helena, Montana 59620

Prepared By:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702

Engineering Services Agreement DSL-AMRB No. 94-006

APRIL 1995

The cover photograph is of the Granite Mountain Mining Co. mill located in Rumsey, Montana. This photograph was graciously provided by the Montana Historical Society for use on this cover.

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TABLE OF CONTENTS

Granite County (Cont'd)

Jefferson County

Lewis & Clark County (Cont'd)				**Page**
	Rimini (Cont'd)	Armstrong	25-102	5- 163
		Beatrice	25-103	5- 164
		Woodrow Wilson	25-258	5- 165
		Peter	25-259	5- 166
		Queensbury	25-262	5- 167
		Monte Cristo	25-275	5- 168
		Upper Valley Forge	25-280/282	5- 169
		National Extension	25-287	5- 170
		Monitor Creek Tailings	25-503	5- 171
		Bear Gulch	25-504	5- 172
	Scratchgravel	Franklin	25-339	5- 173
	Stemple	NE NW S13	25-197	5- 174
		Swansea Tailings/Mine	25-208	5- 175
		SE SW S10	25-212	5- 176
		Astor	25-227	5- 177
		Jay Gould Mine/Millsite	25-500	5- 178
Lincoln County				
	Libby	Snowshoe	27-005	5- 179
		Cherry Creek Millsite	27-006	5- 180
Madison County				
	Norris/Red Bluff	Boaz	29-013	5- 181
		Grubstake	29-399	5- 182
	Pony	Atlantic & Pacific	29-033	5- 183
		Boss Tweed	29-034	5- 184
		Garnet Gold Mine	29-035	5- 185
		Strawberry	29-038	5- 186
		Chicago Mining Corp. Pony Mill	29-500	5- 187
	Rochester	Emma	29-061	5- 188
		Thistle Mine/Millsite	29-073	5- 189
		Watseca	29-075	5- 190
	Sheridan	Smuggler	29-010	5- 191
		Goldschmidt-Steiner	29-078	5- 192
		Red Pine	29-079	5- 193
		Broadgauge	29-293	5- 194
		Latest Out	29-354	5- 195
		Uncle Sam	29-383	5- 196
		Lakeshore	29-436	5- 197
		Buckeye	29-451	5- 198
		SE SW S26 (Keynote)	29-474	5- 199
		NW SE S26	29-476	5- 200
	Silver Star	Broadway/Victoria	29-179	5- 201
	South Boulder	Mammoth	29-008	5- 202
		Mammoth Tailings	29-082	5- 203
	Tidal Wave	B&H	29-083	5- 204
		Dry Gulch South	29-282	5- 205

				Page
Madison County (Cont'd)				
	Virginia City	U.S. Grant	29-095	5- 206
		Belle	29-098	5- 207
		Kearsage	29-102	5- 208
		Apex	29-105	5- 209
		Pacific	29-118	5- 210
		Easton	29-121	5- 211
		Prospect	29-136	5- 212
	Washington	Missouri	29-373	5- 213
		SE SE S25	29-394	5- 214
Meagher County				
	Beaver Creek	Bigler	30-067	5- 215
	Castle Mountain	Cumberland	30-004	5- 216
		Belle of the Castle	30-007	5- 217
	Smith River	SW NE S10	30-078	5- 218
Mineral County				
	Iron Mountain	Iron Mountain Millsite	31-010	5- 219
		Belle of the Hills	31-072	5- 220
		Dillon Millsite	31-073	5- 221
	Keystone	Nancy Lee Mine	31-001	5- 222
		Little Anaconda	31-077	5- 223
		Nancy Lee Millsite	31-082	5- 224
		Nancy Lee Millsite - Slowey	31-090	5- 225
	Packer Creek	Tarbox-Mineral King	31-003	5- 226
		Salteste Consolidate	31-021	5- 227
Missoula County				
	Clinton	Wallace Creek Millsite	32-019	5- 228
	Copper Cliff	Copper Cliff	32-001	5- 229
		Frogs Diner	32-027	5- 230
	Crammer Creek	Linton	32-017	5- 231
	Elk Creek	Morse & Kennedy	32-033	5- 232
	Ninemile	Joe Wallit	32-010	5- 233
		Lost Cabin	32-011	5- 234
		Nugget	32-042	5- 235
	Woodman	Ward Lode	32-005	5- 236
Park County				
	Emigrant	Allison	34-018	5- 237
	New World	Great Republic Smelter	34-000	5- 238
		McLaren Tailings	34-004	5- 239
		Lower Glengarry	34-006	5- 240
		Gold Dust	34-007	5- 241

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

1.0 INTRODUCTION

This document is a compilation of the 1993 and 1994 Hazardous Materials Inventory Summary Reports published by the Montana Department of State Lands/Abandoned Mine Reclamation Bureau (MDSL/AMRB). The Hazardous Materials Inventory was implemented to consistently characterize and rank the extent of environmental problems associated with the Abandoned Hardrock Mine Priority Sites.

The Hazardous Materials Inventory involved the investigation of 269 abandoned or inactive hardrock mine sites in 1993 and an additional 62 mines sites in 1994. This report summarizes the findings of 276 sites from the total 331 sites investigated. Fifty-five sites were dropped from the Abandoned Hardrock Mine Priority Sites list due to a lack of significant environmental hazards associated with the sites. The dropped sites are discussed in Section 4.0.

This report is organized into five sections. Section 1.0 presents the introduction, project objectives, a brief description of the project tasks, and a summary of the findings. Section 2.0 briefly describes field methods used during the inventory. Section 3.0 discusses data evaluation techniques and data management for the project. Section 4.0 presents a brief description of the Abandoned and Inactive Mines Scoring System (AIMSS), which was developed to rank the priority sites. Section 5.0 presents one-page summaries for each priority site. The summaries provide site-specific information, including volumes of wastes, contaminant concentrations, observed releases to surface water and groundwater, water quality criteria exceedances, and potential safety hazards.

This summary report is supported by several other project documents and databases, including:

- The Sampling and Analysis Plan (SAP) presents the sampling approach for the Abandoned Mines Hazardous Materials Inventory. This SAP also contains instructions on completing the Inventory Form and the Standard Operating Procedures (SOPs) for conducting the field sampling activities (AMRB/Pioneer, 1993a and 1994a).

- The Quality Assurance Project Plan (QAPjP) describes quality assurance procedures used for evaluating the field and laboratory data for the project (AMRB/Pioneer, 1993b and 1994b).

- The Laboratory Analytical Protocol (LAP) describes laboratory requirements for the project (AMRB/Pioneer, 1993c and 1994c).

- The Health and Safety Plan (HSP) describes practices and procedures to be followed by field investigators to minimize exposure to hazardous materials and to eliminate any possibility of physical injury (AMRB/Pioneer, 1993d and 1994d).

- The Abandoned Hardrock Mines Project Report is a compilation of the reports listed on the previous page, as well as this Summary Report, the AIMSS Report, the Data Validation/Evaluation Report, and the completed Hazardous Materials Inventory Forms for each site (AMRB/Pioneer, 1993e and 1994e).

- The Abandoned Hardrock Mine Priority Sites, Hazardous Materials Inventory Databases are database files containing all of the data collected from the 1993 and 1994 inventories.

The complete Abandoned Hardrock Mines Project Report including the 1993 and 1994 inventories can be viewed in Helena, Montana, at the Montana State Library; the MDSL/AMRB office; or the Montana Department of Health and Environmental Sciences/Solid and Hazardous Waste Bureau (MDHES/SHWB) office or in Missoula, Montana, at the United States Department of Agriculture/Forest Service (USFS), Region 1 office.

1.1 PROJECT OBJECTIVES

An estimated 6,000 abandoned or inactive hardrock mine and milling sites exist in Montana. This legacy of Montana's mining past has left a wide range of problems and challenges for the MDSL/AMRB and other state and federal agencies charged with reclamating and mitigating of these problems.

The various problems associated with the abandoned and inactive hardrock mine sites range from safety hazards caused by hazardous mine openings, dangerous highwalls, and dilapidated structures to threats to human and non-human life and the environment by mining waste containing elevated heavy metals and other contaminants. To date, the MDSL/AMRB has worked to eliminate the problems of unsafe openings, highwalls, and structures and has made over 1,500 of these sites safer.

In 1991, the MDSL/AMRB concluded that substantial progress had been made in eliminating imminent hazards to public health and safety at abandoned hardrock mine sites. However, limited progress was realized regarding heavy metal and mineral processing reagent contamination of surface water and groundwater. Not only were these sites causing severe environmental degradation, but they were also the sites of highest public concern. Additionally, the MDSL/AMRB recognized a number of other state and federal programs that had resources available to address their problems but that there was no coordinated approach to determine which specific sites should be addressed first. As a result, the MDSL/AMRB solicited various state and federal agencies and requested assistance in identifying of suspected problem sites. The following agencies responded to the MDSL/AMRB's request: USFS-Region 1, the United States Department of the Interior/Bureau of Land Management (BLM), MDHES, and the Montana Department of Natural Resources and Conservation (DNRC). A list of the 269 suspect sites was compiled from the input of these agencies supplemented by a review of existing data from the MDSL/AMRB master inventory. This list included 269 of the highest potential hazard sites in Montana and these sites were investigated and inventoried during the 1993 field season. As a result of the 1993 inventory activities and continued records searches, 62 additional sites were identified, investigated, and ranked during the 1994 field season by the MDSL/AMRB. Of the 331 sites investigated, 55 sites were removed from the list due to a lack of significant environmental hazards (Section 4.0). A list of the remaining 276 sites is presented in Table 1-1.

The agencies previously listed agreed to a cooperative course of action, with MDSL/AMRB designated as the lead agency. The agencies established the following objectives:

- To identify and prioritize the abandoned mine sites that presently pose the most threats to public health and safety and the environment.

- To consistently collect data on each priority site to identify problems associated with each site and to directly compare and rank sites. All sampling and analysis methods strictly follow United States Environmental Protection Agency (EPA) protocols to ensure consistent and accurate results.

- To develop a long-term strategy using statutory and financial resources available to systematically reduce the hazards associated with the prioritized abandoned mine sites.

Once this report is completed, the first two objectives stated above will be fulfilled, and the framework to complete the third objective will be in place.

1.2 PROJECT DESCRIPTION

The priority sites investigated during the 1993 and 1994 field seasons under the Hazardous Materials Inventory were located in 23 counties and in 88 of the 206 mining districts in Montana. Site investigations conducted in 1993 and 1994 required 145 field days to collect the data.

The site investigation conducted at each site involved: overall site reconnaissance; mapping; collection of tailings, slag, waste rock, adit discharge, flooded shafts, stream water, and sediment samples; field analysis of solid matrix samples using an X-ray Fluorescence (XRF) Spectrometer; and measurements of field parameters in water, including flow rates, pH, specific conductance, temperature, oxidation reduction potential, and alkalinity. The field team members also photographed sample locations and significant site features, video taped the site, and evaluated safety hazards.

The 1993 field investigations were conducted in abnormally wet conditions. There were 69 days of measurable precipitation with a total accumulation of 11.2 inches of precipitation (measured in Butte, Montana). During the 1994 investigation period, there

TABLE 1-1: ABANDONED HARDROCK MINE PRIORITY SITES LIST

COUNTY	DISTRICT	SITE NAME	P.A. NO.
Beaverhead	Bannack	Apex Millsite	01-006
Beaverhead	Bannack	Gold Leaf/Priscilla	01-031
Beaverhead	Birch Creek	Indian Queen	01-034
Beaverhead	Elkhorn-South	Old Elkhorn	01-169
Beaverhead	Ermont	Ermont Mines/Millsite	01-005
Beaverhead	Hecla	Silver King	01-094
Beaverhead	Hecla	True Blue	01-138
Beaverhead	Hecla	Upper & Lower Cleve	01-143
Beaverhead	Hecla	Trapper	01-144
Beaverhead	Lemhi Pass	Last Chance No. 1/IER	01-216
Beaverhead	Lost Creek	Tungsten Millsite	01-170
Beaverhead	Wisdom	Clara	01-222
Beaverhead	Wisdom	Martin	01-270
Broadwater	Confederate	Miller Mountain	04-138
Broadwater	Hellgate	Argo Mine/Millsite	04-015
Broadwater	Indian Creek	Park (Marietta)	04-012
Broadwater	Indian Creek	St. Louis	04-013
Broadwater	Indian Creek	Diamond Hill	04-020
Broadwater	Indian Creek	Bullion King	04-061
Broadwater	Radersburg	Ohio	04-009
Broadwater	Radersburg	Keating Tailings	04-121
Broadwater	Winston	Custer Millsite	04-006
Broadwater	Winston	East Pacific	04-008
Broadwater	Winston	Kleinschmidt	04-010
Broadwater	Winston	Vosburg	04-014
Broadwater	Winston	Golden Age	04-050
Broadwater	Winston	Sunrise/January	04-130
Broadwater	Winston	Chartam	04-501
Cascade	Hughesville	Block P Tailings	07-090
Cascade	Hughesville	Bon Ton	07-094
Cascade	Neihart	Broadwater	07-079
Cascade	Neihart	Vilipa	07-080
Cascade	Neihart	Hartley	07-082
Cascade	Neihart	Molton	07-084
Cascade	Neihart	Queen of the Hills	07-085
Cascade	Neihart	Evening Star Mine/Millsite	07-087
Cascade	Neihart	Compromise	07-100
Cascade	Neihart	Carpenter Creek Tailings	07-103
Cascade	Neihart	Rochester	07-110
Cascade	Neihart	Silver Belt	07-111
Cascade	Neihart	Fairplay	07-112
Cascade	Neihart	Stallabrass	07-120
Cascade	Neihart	Dacotah	07-121
Cascade	Neihart	Maud S.	07-129
Cascade	Neihart	Neihart Tailings	07-134
Cascade	Neihart	Silver Dyke Adit	07-135
Cascade	Neihart	Silver Dyke Tailings	07-137
Cascade	Neihart	Silver Dyke Millsite	07-138
Cascade	Neihart	Sherman No. 2 - SW	07-142
Cascade	Neihart	Emma	07-144
Cascade	Neihart	Big Seven	07-156
Cascade	Neihart	Rebellion Mine (Upper & Lower)	07-157
Cascade	Neihart	Ripple Mines	07-163
Cascade	Neihart	Lexington No. 4	07-167
Deer Lodge	Orofino	Champion	12-003
Deer Lodge	Silver Lake	Cable	12-002
Deer Lodge	Silver Lake	Gold Coin Mine	12-004
Deer Lodge	Silver Lake	Silver Lake Millsite	12-070
Fergus	Warm Springs	Gilt Edge Tailings	14-008
Fergus	Warm Springs	Tail Holt	14-010
Fergus	Warm Springs	Cumberland	14-017
Fergus	Warm Springs	Prester John	14-090
Flathead	Hog Heaven	Flathead Mine	15-012
Gallatin	Bozeman	Karst Asbestos	16-018
Granite	Alps	Alps	20-065
Granite	Alps	Argo	20-081
Granite	Antelope Creek	Silver King	20-186
Granite	Antelope Creek	Lori No. 13	20-191
Granite	Antelope Creek	Ant	20-194
Granite	Combination	Combination Millsite	20-009
Granite	Dunkleburg	Forest Rose	20-004
Granite	Dunkleburg	Wasa	20-023
Granite	Dunkleburg	Jackson Park	20-027
Granite	Frog Pond	Millers Mine	20-176
Granite	Garnet	Free Coin/Red Cloud	20-134
Granite	Maxville	Maxville Tailings (Londonderry)	20-209
Granite	Moose Lake	Banner	20-175
Granite	Moose Lake	Old Dominion	20-180
Granite	Philipsburg	Bi-Metallic/Old Red	20-002
Granite	Philipsburg	Douglas Creek Tailings	20-003
Granite	Philipsburg	Algonquin	20-005
Granite	Philipsburg	Rumsey Mine/Millsite	20-018
Granite	Philipsburg	Scratch All	20-019
Granite	Philipsburg	Trout	20-062
Granite	Philipsburg	Little Gem	20-071
Granite	Philipsburg	Wenger No. 2	20-073
Granite	Philipsburg	Granite Mountain	20-110
Granite	Philipsburg	True Fissure	20-111
Granite	South Boulder	Nonpareil	20-012
Granite	South Boulder	Brooklyn	20-025
Jefferson	Alhambra	Middle Fork Warm Springs	22-046
Jefferson	Alhambra	Alhambra Hot Springs	22-049
Jefferson	Alhambra	Solar Silver	22-054
Jefferson	Basin	Bullion	22-008

TABLE 1-1: ABANDONED HARDROCK MINE PRIORITY SITES LIST (Cont'd)

COUNTY	DISTRICT	SITE NAME	P.A. NO.
Jefferson	Basin	Josephine	22-031
Jefferson	Basin	Basin Millsite	22-036
Jefferson	Basin	Perry's Park	22-039
Jefferson	Basin	Buckeye	22-072
Jefferson	Basin	Enterprise	22-074
Jefferson	Basin	Doris	22-293
Jefferson	Basin	Jack Creek Tailings	22-296
Jefferson	Basin	Lady Leith	22-316
Jefferson	Basin	Old Basin Millsite	22-500
Jefferson	Cataract	Mantle (East)	22-032
Jefferson	Cataract	Crystal	22-073
Jefferson	Cataract	Eva May	22-075
Jefferson	Cataract	Morning Glory	22-077
Jefferson	Cataract	Cresent/Alsace	22-106
Jefferson	Cataract	Boulder Chief	22-132
Jefferson	Cataract	Rocker/Ada	22-170
Jefferson	Clancy	Nellie Grant	22-244
Jefferson	Clancy	General Grant	22-245
Jefferson	Colorado	Alta	22-001
Jefferson	Colorado	Bertha	22-002
Jefferson	Colorado	Bluebird	22-003
Jefferson	Colorado	Corbin Flats	22-004
Jefferson	Colorado	Gregory	22-005
Jefferson	Colorado	Washington	22-007
Jefferson	Colorado	Crawley Camp	22-028
Jefferson	Colorado	Argentine	22-102
Jefferson	Colorado	Wickes Smelter	22-358
Jefferson	Elkhorn	Elkhorn Queen	22-027
Jefferson	Elkhorn	Queen (Tourmaline)	22-111
Jefferson	Elkhorn	Tacoma	22-284
Jefferson	Elkhorn	Sourdough	22-336
Jefferson	Elkhorn	Carmody	22-337
Jefferson	Elkhorn	Iron	22-359
Jefferson	Elkhorn	Trumley Heap Leach	22-501
Jefferson	Elkhorn	Elkhorn Creek Tailings	22-502
Jefferson	High Ore	Comet Tailings	22-009
Jefferson	High Ore	Grey Eagle	22-029
Judith Basin	Hughesville	Block P Mine	23-001
Judith Basin	Hughesville	Marcelline	23-022
Judith Basin	Hughesville	Belt Patent	23-035
Judith Basin	Hughesville	NE NE S7 (Lucky Strike)	23-042
Judith Basin	Hughesville	Wright Lode	23-045
Judith Basin	Hughesville	Edwards Lode	23-046
Judith Basin	Hughesville	Harrison/Moulton	23-056
Judith Basin	Hughesville	Moulton	23-058
Judith Basin	Hughesville	Tiger	23-059
Judith Basin	Hughesville	Danny T	23-500

COUNTY	DISTRICT	SITE NAME	P.A. NO.
Lewis & Clark	Helena	Spring Hill Tailings	25-067
Lewis & Clark	Helena	Josyln Street Tailings	25-501
Lewis & Clark	Lincoln	Seven-Up Pete/Rover	25-020
Lewis & Clark	Lincoln	Blackfoot Tailings	25-322
Lewis & Clark	Marysville	Drumlummon Mine/Mill/Tailings	25-024
Lewis & Clark	Marysville	Bald Mountain	25-061
Lewis & Clark	Marysville	Big Ox Millsite	25-115
Lewis & Clark	Marysville	Big Ox Mine	25-116
Lewis & Clark	Marysville	Belmont	25-167
Lewis & Clark	Marysville	Piegan/Gloster Millsite	25-172
Lewis & Clark	Marysville	Empire Millsite	25-175
Lewis & Clark	Marysville	Bald Butte Millsite	25-179
Lewis & Clark	Marysville	Wildcat	25-317
Lewis & Clark	Marysville	Goldsil Millsite	25-365
Lewis & Clark	Orphir	Victory/Evening Star	25-010
Lewis & Clark	Rimini	Tenmile Mine	25-005
Lewis & Clark	Rimini	Peerless Jenny/King	25-006
Lewis & Clark	Rimini	Red Water	25-007
Lewis & Clark	Rimini	Valley Forge/Susie	25-008
Lewis & Clark	Rimini	Red Mountain (13)	25-019
Lewis & Clark	Rimini	Lower Tenmile Millsite	25-030
Lewis & Clark	Rimini	Armstrong	25-102
Lewis & Clark	Rimini	Beatrice	25-103
Lewis & Clark	Rimini	Woodrow Wilson	25-258
Lewis & Clark	Rimini	Peter	25-259
Lewis & Clark	Rimini	Queensbury	25-262
Lewis & Clark	Rimini	Monte Cristo	25-275
Lewis & Clark	Rimini	Upper Valley Forge	25-280/282
Lewis & Clark	Rimini	National Extension	25-287
Lewis & Clark	Rimini	Monitor Creek Tailings	25-503
Lewis & Clark	Rimini	Bear Gulch	25-504
Lewis & Clark	Scratchgravel	Franklin	25-339
Lewis & Clark	Stemple	NE NW S13	25-197
Lewis & Clark	Stemple	Swansea Tailings/Mine	25-208
Lewis & Clark	Stemple	SE SW S10	25-212
Lewis & Clark	Stemple	Astor	25-227
Lewis & Clark	Stemple	Jay Gould Mine/Millsite	25-500
Lincoln	Libby	Snowshoe	27-005
Lincoln	Libby	Cherry Creek Millsite	27-006
Madison	Norris/Red Bluff	Boaz	29-013
Madison	Norris/Red Bluff	Grubstake	29-399
Madison	Pony	Atlantic & Pacific	29-033
Madison	Pony	Boss Tweed	29-034
Madison	Pony	Garnet Gold Mine	29-035
Madison	Pony	Strawberry	29-038
Madison	Pony	Chicago Mining Corp. Pony Mill	29-500
Madison	Rochester	Emma	29-061

TABLE 1-1: ABANDONED HARDROCK MINE PRIORITY SITES LIST (Cont'd)

COUNTY	DISTRICT	SITE NAME	P.A. NO.
Madison	Rochester	Thistle Mine/Millsite	29-073
Madison	Rochester	Watseca	29-075
Madison	Sheridan	Smuggler	29-010
Madison	Sheridan	Goldschmidt-Steiner	29-078
Madison	Sheridan	Red Pine	29-079
Madison	Sheridan	Broadgauge	29-293
Madison	Sheridan	Latest Out	29-354
Madison	Sheridan	Uncle Sam	29-383
Madison	Sheridan	Lakeshore	29-438
Madison	Sheridan	Buckeye	29-451
Madison	Sheridan	SE SW S26 (Keynote)	29-474
Madison	Sheridan	NW SE S26	29-476
Madison	Silver Star	Broadway/Victoria	29-179
Madison	South Boulder	Mammoth	29-008
Madison	South Boulder	Mammoth Tailings	29-082
Madison	Tidal Wave	B&H	29-083
Madison	Tidal Wave	Dry Gulch South	29-282
Madison	Virginia City	U.S. Grant	29-095
Madison	Virginia City	Belle	29-098
Madison	Virginia City	Kearsage	29-102
Madison	Virginia City	Apex	29-105
Madison	Virginia City	Pacific	29-118
Madison	Virginia City	Easton	29-121
Madison	Virginia City	Prospect	29-136
Madison	Washington	Missouri	29-373
Madison	Washington	SE SE S25	29-394
Meagher	Beaver Creek	Bigler	30-067
Meagher	Castle Mountain	Cumberland	30-004
Meagher	Castle Mountain	Belle of the Castle	30-007
Meagher	Smith River	SW NE S10	30-078
Mineral	Iron Mountain	Iron Mountain Millsite	31-010
Mineral	Iron Mountain	Belle of the Hills	31-072
Mineral	Iron Mountain	Dillon Millsite	31-073
Mineral	Keystone	Nancy Lee Mine	31-001
Mineral	Keystone	Little Anaconda	31-077
Mineral	Keystone	Nancy Lee Millsite	31-082
Mineral	Keystone	Nancy Lee Millsite - Slowey	31-090
Mineral	Packer Creek	Tarbox-Mineral King	31-003
Mineral	Packer Creek	Saltese Consolidate	31-021
Missoula	Clinton	Wallace Creek Millsite	32-019
Missoula	Copper Cliff	Copper Cliff	32-001
Missoula	Copper Cliff	Frogs Diner	32-027
Missoula	Crammer Creek	Linton	32-017
Missoula	Elk Creek	Morse & Kennedy	32-033

COUNTY	DISTRICT	SITE NAME	P.A. NO.
Missoula	Ninemile	Joe Wallit	32-010
Missoula	Ninemile	Lost Cabin	32-011
Missoula	Ninemile	Nugget	32-042
Missoula	Woodman	Ward Lode	32-005
Park	Emigrant	Allison	34-018
Park	New World	Great Republic Smelter	34-000
Park	New World	McLaren Tailings	34-004
Park	New World	Lower Glengarry	34-006
Park	New World	Gold Dust	34-007
Park	New World	Little Daisy	34-009
Park	New World	McLaren Mine	34-010
Park	New World	Black Warrior	34-079
Park	New World	Upper Alice E.	34-085
Park	New World	Fisher Creek No. 1	34-090
Powell	Elliston	Charter Oak	39-003
Powell	Elliston	Lily/Orphan Boy	39-006
Powell	Elliston	Monarch	39-008
Powell	Elliston	Ontario Millsite	39-010
Powell	Elliston	Golden Anchor	39-012
Powell	Elliston	Hard Luck	39-014
Powell	Elliston	Kimball	39-016
Powell	Elliston	Sure Thing	39-020
Powell	Elliston	Julia	39-022
Powell	Elliston	Telegraph	39-023
Powell	Elliston	Third Term	39-024
Powell	Elliston	Anna R./Hattie M.	39-044
Powell	Elliston	Mountain View	39-062
Powell	Emery	Emery	39-004
Ravalli	Curlew	Curlew	41-003
Ravalli	Frog Pond	Montana Prince	41-004
Ravalli	Pleasant View	Blue Bird	41-009
Sanders	Blue Creek	Broken Hill	45-005
Sanders	Plains	Montro Gold	45-010
Sanders	Plains	Lower Letterman	45-047
Sanders	Trout Creek	Holliday (Silver Mark)	45-009
Sanders	White Pine	Jack Waite	45-002
Silver Bow	Basin Creek	Highland Mine	47-028
Silver Bow	Elk Park	Mary Emmee/Clinton	47-035
Silver Bow	Elk Park	Rising Sun	47-037
Silver Bow	Melrose	Old Glory	47-027
Silver Bow	Melrose	Clipper	47-029
Silver Bow	Moose Creek	Middle Fork Millsite	47-081
Stillwater	Stillwater	Benbow Millsite	48-005
Sweet Grass	Independence	Yager/Daisy	49-002

were 22 days of measurable precipitation with a total accumulation of only 3.40 inches of precipitation (measured in Butte, Montana). The reduced amount of precipitation in 1994 may have resulted in a decrease in the observed and, therefore, documented releases to surface water that would have been occurring under 1993 conditions. The 40-year average accumulation for this period is 6.4 inches for the same location.

The physical setting and topography associated with these sites ranged from gently sloping land in valley bottoms to very steep, high elevation, mountainous areas. Site access was often difficult due to poor road conditions or to the absence of maintained roads. Several sites were accessed by foot or by helicopter only. Ownership of the priority sites was a mix of public lands (USFS, BLM, MDSL, etc.) and patented lands (private ownership). The priority sites consisted of primarily inactive/abandoned mine sites; however, exploration activities were in progress at several sites.

Significant features at the sites included tailings ponds, impoundments, and piles; waste rock dumps or piles; mine openings, including adits, shafts, glory holes, and exploration trenches; miscellaneous buildings and structures; and roads. Mine opening discharges and streams adjacent to or flowing through the sites were common.

Hazardous materials observed at some of the sites included chemical reagents, solvents, asbestos-containing material, petroleum fuels or lubricating oils storage (barrels or tanks), and miscellaneous power supply items (poles, transformers, lines, etc.). Some of the sites support wildlife, domestic grazing, or aquatic life. Residential occupation of the sites was observed in rare cases; however, residences adjacent to the sites occurred more frequently.

1.3 SUMMARY OF FINDINGS

The following information is provided as an overview of the data compiled during the 1993 and 1994 investigations for the Hazardous Materials Inventory.

Laboratory Sampling
- Total number of laboratory samples: 1,963 (does not include the quality assurance/quality control [QA/QC] duplicates), representing approximately 43,200 data points generated by the laboratories.
- Total number of XRF Spectrometer samples: 3,690 (does not include the QA/QC duplicates), representing approximately 77,500 data points.

Waste Rock Associated with the Priority Sites
- Estimated total volume: 6,983,000 cubic yards.
- Estimated total area: 16,869,000 square feet (387 acres).
- Estimated total unvegetated/uncovered area: 15,562,000 square feet (357 acres).

Mill Tailings Associated with the Priority Sites

- Estimated total volume: 8,550,000 cubic yards.
- Estimated total area: 21,671,000 square feet (498 acres).
- Estimated unvegetated/uncovered area: 14,214,000 square feet (326 acres).

Adit Discharges Associated with the Priority Sites

- Total number of discharging adits: 198.
- Number of adit discharges with pH $\leq$ 5.00: 33.
- Number of adit discharges with pH $\leq$ 6.00: 48.

Flooded Shafts Associated with the Priority Sites

- Total number of open shafts with water: 13.
- Shafts with pH $\leq$ 5.00: 3.

Water Quality Criteria

- Number of discharges exceeding Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs): 93 (87 were adits and 6 were shafts).
- Number of adit discharges exceeding acute aquatic life criteria: 76.
- Number of observed releases to surface water/sediment directly attributable: 148.

2.0 INVESTIGATION METHODS

2.1 DATABASE AND LITERATURE SEARCH

Data collected in the field was supplemented by an extensive literature search and by using several computer databases. This supplemental information was used to complete the inventory forms and to fulfill receptor information requirements for the AIMSS. The computer databases used to collect this information were:

- The Montana Bureau of Mines and Geology (MBMG) Well Logs Database, which was compiled by the MBMG and the DNRC. This database was used to estimate the number of wells within a one-mile and a four-mile radius of each site.

- The Montana Rivers Information System (MRIS), which was compiled by the Montana State Library for the Montana Department of Fish, Wildlife, and Parks (MDFWP). This database was used to classify riparian habitat quality, wetlands frontage, fisheries habitat and species classification, and sport fisheries classification for stream reaches potentially impacted by each site.

- The MDHES/Water Quality Bureau (WQB) - Community Water Supplies Database provided a list of surface water resources presently used for drinking water supplies in Montana.

Additional information was obtained from the following sources:

- Peak and average stream flow estimates were obtained from United States Department of Interior/Geological Survey (USGS) flow monitoring reports on gaged streams.

- Population estimates were obtained by counting buildings delineated on the USGS quadrangle maps and USFS Forest Visitors Maps. Field observations supplemented this information.

- Land ownership was determined from MDSL/AMRB records or USFS Forest Visitor Maps.

- Historic mine/millsite operations, mineralogy, and geology were obtained from several sources, including United States Bureau of Mines (USBM) circulars; USGS bulletins and professional papers; and MBMG memoirs, bulletins, and circulars.

- Historic analytical data were obtained from the MDSL/AMRB project files, the MDHES/SHWB project files, the MDHES/WQB, USFS project files, and MBMG data collected for the USFS. This data was reviewed before site visits to provide the investigators with background information on potential site hazards.

2.2 FIELD METHODS

A detailed discussion of specific investigation methodologies is found in the MDSL/AMRB Hazardous Materials Inventory SAP (AMRB/Pioneer, 1993a and 1994a). This section describes some of the unique details of the investigative methods used to fulfill the project objectives.

The inventory form used during the 1994 investigation was almost identical to the 1993 form except for some with minor improvements that removed redundancies and streamlined decision-making processes. The inventory form is used during the investigation to guide and focus the investigative tasks to ensure consistent evaluation of each site. Literature and database searches were performed before the field investigations to provide investigators with background information on each site.

Sampling was performed on waste rock dumps, mill tailings, streams, ponds, adit discharges, flooded shafts, and on domestic groundwater wells or monitoring wells, when present.

Each tailing's feature was characterized both spatially and vertically by hand-auguring to determine accurate depths and to delineate stratification or differences in metals concentrations between the upper-oxidized zone(s) and the lower reduced zones. Subsamples were collected from each visually different strata.

Typically, several subsamples were collected from each waste rock dump to better characterize very heterogeneous waste sources. Subsamples from the tailings and waste rock were analyzed in the field using an XRF Spectrometer. The field screening data allowed the investigators to make informed decisions on the number of samples required for laboratory analyses and indicated how best to composite the subsamples from the potential sources to send representative samples to the laboratory, while minimizing the number of samples to achieve this end. The XRF Spectrometer analyses also provided an increased number of valid and discrete data points per site achieving a more thorough understanding of the problems associated with each site. Solids were characterized additionally by measuring pH and radioactivity.

Stream sediment samples were also analyzed in the field using the XRF Spectrometer to assist in assessing the extent of contamination and migration from the waste sources.

Surface water sampling was often conducted to characterize impacts to drainage basins, as well as contributions from individual sites when multiple sources were present. Waters were additionally characterized in the field by measuring flow rates, pH, specific conductance, alkalinity, and temperature.

Site mapping was conducted using standard "Chain and Compass" surveying techniques during the 1993 field season and the Global Positioning System during the 1994 field season. Mapping was primarily conducted to estimate the volume and area of waste sources and record sample locations. Other significant site features, such as streams or drainages, roads, mine openings, and structures, were also recorded on the site sketches. Sample locations and other significant site features were documented on photographic slides and video tape to assist the resource managers in evaluating the priority sites.

3.0 DATA EVALUATION AND COMPARISONS

This section discusses data quality validation and evaluations, as well as comparisons of the data to pertinent criteria.

3.1 DATA VALIDATION AND EVALUATION

3.1.1 Laboratory Data Validation and Evaluation

The laboratory used during this investigation complied all of the QA/QC performance requirements defined in the EPA Contract Laboratory Program (CLP) Statement of Work (SOW, March 1990). The data packages provided by the laboratory allowed comprehensive data validation and evaluation procedures to be completed. Laboratory data validation and evaluation were performed according to guidelines developed by the EPA.

The laboratory data were validated in accordance with Laboratory Data Validation Functional Guidelines for Evaluating Inorganics (EPA, 1988). The data validation procedures were performed partially by laboratory chemists and partially by a data reviewer from Pioneer Technical Services, Inc. The data validation procedure evaluated:

- holding times;
- initial and continuing calibrations;
- calibration and preparation blanks;
- inductively coupled plasma (ICP) interference check samples;
- laboratory control samples (LCS);
- laboratory duplicate sample analyses (precision assessment);
- matrix spike sample analyses (accuracy assessment);
- furnace atomic absorption (AA) quality control;
- ICP serial dilutions;
- sample result verification;
- field duplicate analyses (precision assessment);
- field blank analyses; and
- overall data for the case.

Data evaluation occurred after the data validation process was completed and the appropriate qualifiers had been applied to the data. The data evaluation process involved a statistical analysis of the data to identify outliers and to assess the overall quality of the data. Data evaluation was performed on the laboratory data which met the Data Quality Objectives (DQOs) outlined in the QAPjP for the Abandoned Mines Hazardous Materials Inventory (AMRB/Pioneer, 1993b and 1994b).

Although numerous qualifications (flags) were applied to the laboratory data compiled during this investigation, and a small portion of the data were evaluated as outliers, none of the data were flagged "R" or were otherwise considered unusable. Consequently, 100 percent of the laboratory data (soil and water) collected during this investigation are considered valid and useable for all objectives of this project.

The data's limitations should be considered when making interpretations. Please refer to Data Validation and Evaluation Report for the Abandoned Mines Hazardous Materials Inventory (AMRB/Pioneer, 1993f and 1994f) for a detailed description of the procedures followed and results provided by the overall data assessments.

3.1.2 X-Ray Fluorescence Spectrometer Data Validation

Data provided by the field portable XRF Spectrometer were also validated; the XRF data were validated according to manufacturer specifications. The validation procedures for XRF data were not nearly as rigorous as for laboratory data; consequently, additional procedures, using standard statistical techniques, were employed to evaluate the overall quality of the XRF data. These additional procedures included assessment of XRF duplicate data to quantify precision, as well as comparing XRF data to corresponding laboratory data to assess inter-method precision and correlation.

The comprehensive evaluation of the XRF data determined that inter-method precision was good for all analytes, and the XRF data showed excellent correlation with the laboratory data.

3.1.3 Other Field Measurements

Field parameter measurements, such as pH, Eh, and specific conductance, were not evaluated for data quality. SOPs (AMRB/Pioneer, 1993a and 1994a) were carefully followed in the field to achieve a consistent and acceptable level of quality.

3.2 DATA INTERPRETATION

The analytical data collected were compared to site-specific background or upgradient concentrations, as well as to drinking water standards and aquatic life criteria. The following sections explain how these comparisons were made.

3.2.1 Background Soil Comparison

Background soil samples were collected to establish the extent to which metals concentrations were elevated in comparison to the local background. Background samples were typically applied to groups of sites within close proximity to one another and within similar geologic units.

3.2.2 Observed Releases to Groundwater, Surface Water, and Sediment

An observed release to surface water is defined as a downstream surface water or stream sediment concentration at more than three times the upstream surface water or sediment concentration for any constituent that can be attributed to the site. Groundwater, surface water, and stream sediment analytical data were used to document observed releases from the priority sites.

3.2.3 MCL/MCLG, and Aquatic Life Criteria Comparisons

MCLs and MCLGs are drinking water standards promulgated under the federal SDWA (40 CFR Parts 141, 143). MCLs and MCLGs apply to public water systems; however, they may be relevant and appropriate to surface or groundwater if those waters are used as drinking water. Groundwater and surface water metals concentrations observed in samples collected were evaluated against these standards. The current SDWA MCLs and MCLGs expressed in micrograms per liter (ug/L) are:

Arsenic: 50 ug/L	Barium: 2,000 ug/L	Cadmium: 5 ug/L
Copper: 1,300 ug/L	Chromium: 100 ug/L	Mercury: 2 ug/L
Nickel: 100 ug/L	Antimony: 6 ug/L	Lead: 15 ug/L
Cyanide: 200 ug/L		

Surface water and mine discharge analytical results were also evaluated against freshwater acute and chronic aquatic life criteria (MDHES/WQB, 1994). Some of these criteria are expressed as a function of total hardness and were corrected for the hardness measured in each sample, when applicable.

3.3 DATA MANAGEMENT

The data collected under this project has been input into the data manager, dBase IV - Version 2.0. Four files were created to contain the data and to aid in manipulating the data, if desired. These files are summarized briefly below.

- PTSDATA.DBF contains field data collected for each sample during the Hazardous Materials Inventory.
- XRFDATA.DBF contains the analyses done by the field XRF data generated during the Hazardous Materials Inventory.
- LABDATA.DBF contains the data from all of the laboratory analyses performed during the Hazardous Materials Inventory.
- PRIORITY.DBF is the modified dBase file provided to Pioneer by MDSL/AMRB from the master inventory.

The information from these four files can be readily combined with one another to form a relational database.

4.0 SITE RANKING

The final task of the Hazardous Materials Inventory involved the development of a system to rank the severity of hazards or environmental threats associated with the sites investigated to assist the MDSL/AMRB in prioritizing reclamation efforts and in allocating resources. This system, the Abandoned and Inactive Mines Scoring System (AIMSS), closely follows the EPA's Hazard Ranking System although the AIMSS is specifically focused on potential hazards typically associated with the abandoned or inactive hardrock mines.

The AIMSS also evaluated potential safety hazards associated with the sites such as hazardous mine openings, highwalls, and structures, and generated a separate safety score for each site. The AIMSS used the data collected for each site to assign a ranking score.

The AIMSS is focused towards the physical site setting and potential hazards associated with abandoned and inactive mines due to its capability to evaluate mine opening discharges and large quantities of mine wastes. The AIMSS scoring method evaluates relative risks between sites which accounts for site-specific contaminant concentrations and the varying toxicity of different constituents, as well as adit discharges in the source evaluation. This scoring method more effectively discriminates between sites with higher concentrations or more toxic constituents in relation to sites with lower concentrations or less toxic constituents. To generate an overall Mine Site Human Health and Environmental Hazard Score, the AIMSS evaluates the groundwater pathway, surface water pathway, air pathway, and direct contact pathway. Under each pathway, the AIMSS evaluates observed releases, potential to release, pathway characteristics, waste characteristics, and targets.

Table 4-1 lists the screened priority sites and their associated AIMSS score, sorted in descending order. Three of the 276 sites were not ranked due to complications with inaccessibility; therefore, no data was collected.

The AIMSS also generates a distinct safety score for each site by evaluating site accessibility and safety hazards present (i.e., shafts, stopes, open adits, hazardous structures, and explosives/other hazardous materials or chemicals). Table 4-2 lists the screened priority sites and their associated safety score, sorted in descending order.

The Hazardous Materials Inventory involved the investigation of 331 abandoned or inactive hardrock mine sites. Fifty-five sites were dropped from the Abandoned Hardrock Mine Priority Sites list due to a lack of any significant environmental hazards associated with these sites. Table 4-3 lists the dropped sites. These sites were removed from the priority list because they did not represent a significant risk to human health or the environment for one or more of the following reasons:

- The site did not contain significant concentrations or quantities of heavy metals or other potentially hazardous materials;
- Contaminant migration pathways were not present to potentially impact human health or the environment;
- Active mining was occurring on the sites at the time of the investigation, preventing accurate characterization of the risks as an abandoned or inactive mine site; or
- Sites had been previously reclaimed and risks to human health and the environment had been adequately addressed.

The sites dropped may require additional evaluation at some time in the future due to the potential for changing site conditions or regulatory statutes. These sites may be reinstated on the Abandoned Hardrock Mine Priority Sites List, if warranted.

United States Environmental Protection Agency | Solid Waste and Emergency Response | EPA 540-F-94-028 OSWER 9285.7-14FS PB94-963311 November 1996

EPA

Using Qualified Data to Document an Observed Release and Observed Contamination

Office of Emergency and Remedial Response (5204G) Quick Reference Fact Sheet

This fact sheet discusses the use of the U.S. Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) data and other sources of data qualified with a "J", "U", or "UJ" qualifier or flag. This guidance provides a management decision tool for the optional use of qualified data to document an observed release and observed contamination by chemical analysis under EPA's Hazard Ranking System (HRS). The analyte and sample matrix (i.e., soil or water) specific adjustment factors given in this fact sheet allow biased CLP and non-CLP data to be adjusted to meet the HRS criteria for documenting an observed release and observed contamination with data that are of known and documented quality. This fact sheet does not address using qualified data for identifying hazardous substances in a source.

INTRODUCTION

The EPA established the HRS to rank hazardous waste sites for National Priorities List (NPL) purposes under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCL amended by the Superfund Amendments Reauthorization Act of 1986 (SARA). This fact sh was developed in response to a need to determine the usability of qualified data for site assessment and HRS scoring purposes. This fact sheet illustrates that qualified data are often of sufficiently known and documented quality, and may be used in establishing an observed release and observed contamination. This fact sheet explains the rationale for why some qualified data may be used for HRS purposes; presents the background information needed to use qualified data with and without adjustment factors; provides examples of qualified data use; and discusses issues raised during the development of the adjustment factor approach.

Under the HRS, chemical analytical data are often used to demonstrate an observed release and observed contamination when the release sample concentration is three times the background concentration and background levels are greater than or equal to the appropriate detection limit; or if the release sample concentration is greater than or equal to the appropriate quantitation limit when background levels are below the appropriate detection limit. The release must also be at least partially attributable to the site under investigation (*Hazard Ranking System, Final Rule*, 40 CFR Part 300, App. A). The data used to establish the release must be of known and documented quality. (*Hazard Ranking System Guidance Manual*, Interim Final, November 1992, OSWER Directive 9345.1-07). Data that cannot be validated may not be of known and documented quality. For more information on observed release and observed contamination, refer to the fact sheets: *Establishing an Observed Release*, September 1995, PB94-963314; *Establishing Areas of Observed Contamination*, September 1995, PB94-963312; and *Establishing Background Levels*, September 1995, PB94-963313. The factor of three represents the minimum difference in sample results that demonstrate an increase in contaminant concentration above background levels, with reasonable confidence.

Although much of the analytical data used for identifying an observed release is generated under EPA's CLP, this fact sheet applies to all data regardless of the source of the data (non-CLP data). EPA procedures require that

CLP analytical data be reviewed, or validated by EPA or third party reviewers, to ensure the data are of known and documented quality and that the determination be discussed in a data validation report that accompanies the analytical results. Based on this data validation, CLP data are classified into three categories: (1) data for which all quality control (QC) requirements have passed contract-required acceptance criteria; (2) data for which at least one QC requirement has not met acceptance criteria; and (3) data for which most or all QC requirements have not met acceptance criteria. Data in the first category typically are not qualified. Data in the second category are often qualified with a "J" qualifier and, as discussed in this fact sheet, are usually usable for HRS purposes. Data in the third category are usually qualified by an "R" qualifier and are not usable for HRS purposes.

Whether data are placed into the second or third category is determined by the amount of bias associated with the analytical results. Data validation evaluates biases resulting from laboratory analytical deficiencies or sample matrices to determine whether the data are usable. Bias indicates that the reported concentration is either higher or lower than the true concentration, and the data validation report identifies the direction of the bias or if the bias is unknown.

The EPA CLP also sets minimum quantitation limits for all analytes; the Contract Required Quantitation Limit (CRQL) for organic analytes and the Contract Required Detection Limit (CRDL) for inorganic analytes. For HRS purposes and for this fact sheet, the term CRQL refers to both the contract required quantitation limit and the contract required detection limit. (40 CFR Part 300, App. A). The CRQLs are substance specific levels that a CLP laboratory must be able to routinely and reliably detect in specific sample matrices (i.e.; soil, water, sediment). The CRQLs are usually set above most instrument detection limits (IDLs) and method detection limits (MDLs).

CONSIDERATIONS FOR NON-CLP DATA

Because various laboratories and analytical methods may be used to develop non-CLP data, the following list provides the general information sufficient for determining whether non-CLP data are usable for HRS purposes.

(1) Identification of the method used for analysis. Methods include RCRA methods, SW-846, EPA methods, etc.
(2) Quality control (QC) data. Check each method of analysis to determine if specific QC requirements are defined. If not, seek out another method.
(3) Instrument-generated data sheets for sample results. These data sheets would be the equivalent of Form I's in CLP data.
(4) MDLs and sample quantitation limits (SQLs). The analytical method should provide the MDL. The SQL is an adjusted MDL using sample specific measurements such as percent moisture and weight.
(5) Data validation report.

USE OF BIASED QUALIFIED DATA

In the past, all qualified data have been inappropriately perceived by some people as data of low confidence or poor quality and have not been used for HRS evaluation. With careful assessment of the nature of the analytical biases or QC deficiencies in the data on a case-by-case basis, qualified data can represent an additional resource of data for establishing an observed release. Further, the D.C. District Court of Appeals in 1996 upheld EPA's case-by-case approach to assess data quality. In reviewing the use of qualified data to identify an observed release, the Court stated that if there are deficiencies in the data, "...the appropriate response is to review the deficiencies on a 'case-by-case basis' to determine their impact on 'usability of the data.'" The Court also stated with regards to data quality that, "...EPA does not face a standard of absolute perfection....Rather, it is statutorily required to 'assure, to the maximum extent *feasible*,' that it 'accurately assesses the relative degree of risk' posed by sites" [*Board of Regents of the University of Washington, et al., v. EPA*, No. 95-1324, slip op. at 8-10 (D.C. Cir. June 25, 1996).]

As discussed in this fact sheet, the application of adjustment factors to "J" qualified data can serve as a management decision tool to "adjust," or take into account, the analytical uncertainty in the data indicated by the qualifier, thereby making qualified data usable for HRS evaluation. The use of adjustment factors to account for the larger uncertainty in "J" qualified data is a conservative approach enabling a quantitative comparison of the data for use in documenting an observed release. It should be noted that the use of adjustment factors only addresses analytical variability and does not take into account variabilities which may be introduced during field sampling. Some guidelines for using the adjustment factor approach are discussed in Exhibit 1.

CLP QA/QC PROCEDURES

CLP qualifiers are applied to analytical data based on the results of various Quality Assurance/Quality Control (QA/QC) procedures used at the laboratory. EPA analytical methods use a number of QA/QC mechanisms during sample analysis in order to assess qualitative and quantitative accuracy (*Contract Laboratory Program Statement of Work for Inorganic Analyses*, Document No. ILM02.0; *Contract Laboratory Program Statement of Work for Organic Analyses*, Document No. OLM1.8; *Quality Assurance/Quality Control Samples*, Environmental Response Team Quality Assurance Technical Information Bulletin; *Test Methods for Evaluating Solid Waste (SW-846): Physical and Chemical Methods*, Document No. SW-846). To assess data quality, the laboratory uses matrix spikes, matrix spike duplicates, laboratory control samples, surrogates, blanks, laboratory duplicates, and quarterly blind performance evaluation (PE) samples. The Agency assumes that if biases are found in the QA/QC samples, the field sample concentrations may also be biased.

Surrogates are chemically similar to the analytes of interest. They are added or "spiked" at a known concentration into the field samples before analysis. Also, selected target analytes are "spiked" into samples at a specified frequency to assess potential interferences from the sample matrix. These samples are called matrix spikes. Comparison of the known concentration of the surrogates and matrix spikes with their actual analytical results reflects the analytical accuracy. Because the surrogates are expected to behave similarly to the target analytes, they may indicate bias caused by interferences from the sample matrices. These types of interferences from the sample matrix are known as matrix effects (*CLP National Functional Guidelines for Inorganic Data Review*, Publication 9240.1-05-01; *CLP National Functional Guidelines for Organic Data Review*, Publication 9240.1-05; *Test Methods for Evaluating Solid Waste (SW-846): Physical and Chemical Methods*, Document No. SW-846).

Laboratory control samples are zero blind samples which contain known concentrations of specific analytes and are analyzed in the same batch as field samples. Their results are used to measure laboratory accuracy. Blanks are analyzed to detect any extraneous contamination introduced either in the field or in the laboratory.

Laboratory duplicates are created when one sample undergoes two separate analyses. The duplicate results are compared to determine laboratory precision. Quarterly blind PE samples are single blind samples that evaluate the laboratory's capability of performing the specified analytical protocol.

CLP and other EPA analytical methods include specifications for acceptable analyte identification, target analytes, and minimum and maximum percent recovery of the QA/QC compounds. Data are validated according to guidelines which set performance criteria for instrument calibration, analyte identification, and identification and recovery of QA/QC compounds (*CLP Statement of Work and SW-846*). The *National Functional Guidelines for Data Review*, used in EPA validation, was designed for the assessment of data generated under the CLP organic and inorganic analytical protocols (*CLP Statement of Work; National Functional Guidelines for Data Review*). The guidelines do not preclude the validation of field and other non-CLP data. Thus, many EPA Regions have also adapted the *National Functional Guidelines for Data Review* to validate non-CLP data. Data which do not meet the guidelines' performance criteria are qualified to indicate bias or QA/QC deficiencies. The data validation report usually explains why the data were qualified and indicates the bias direction when it can be determined. Validated data that are not qualified are considered unbiased and can be used at their reported numerical value for HRS evaluation.

QUALIFIER DEFINITIONS

Most EPA validation guidelines use the data qualifiers presented in Exhibit 2 (*CLP National Functional Guidelines for Data Review*). Other qualifiers besides these may be used; the validation report should always be checked for the exact list of qualifiers and their meanings.

It should be emphasized that not meeting one or some of the contract required QA/QC acceptance criteria is often an indication that the sample was difficult to analyze, not that there is low confidence in the analysis (i.e., the

EXHIBIT 1 GUIDELINES FOR THE USE OF ADJUSTMENT FACTORS
• The use of adjustment factors identified in this fact sheet is a management tool for the optional use of "J" qualified data generated under CLP or other sources of data to document an observed release.
• Adjusted qualified data should be used with non-qualified data whenever possible.
• EPA maintains a "worst sites first" policy for placing sites on the NPL (*Additional Guidance on "Worst Sites" and "NPL Caliber Sites" to assist in SACM Implementation*, OSWER Directive 9320.2-07).
• EPA Regions should use adjustment factors with discretion on a case-by-case basis and should always carefully consider the use of qualified data in borderline cases.
• Resampling and/or reanalysis may be warranted if qualified data do not appear adequate to document an observed release.
• EPA Regions may substitute higher adjustment factors based on documented, justifiable reasons but may never use a lower adjustment factor value.
• The adjustment factors should only be applied to analytes listed in the tables. These adjustment factors should not be interpolated or extrapolated to develop factors for analytes not listed in the tables.
• The adjustment factors apply only to "J" qualified data above the CRQL.
• Detection below the CRQL is treated as non-quantifiable for HRS purposes.
• "UJ" data may be used under strict circumstances as explained in this fact sheet.
• The adjustment factors only apply to biased "J" qualified data, not to other "J" qualified data.
• The adjustment factors do not apply to "N", "NJ", or "R" qualified data. These data can not be used to document an observed release for HRS purposes.

analysis is "under control" and can be adequate for HRS decision making). Often "J", "U", and "UJ" qualified data fall into this category.

There are instances when qualified data cannot be used since the uncertainty of the results is unknown. For example, violations of laboratory instrument calibration and tuning requirements, and gross violations of holding times reflect the possibility that the results are of unknown quality (i.e., the analysis is "out of control"). Most often these data would be qualified with an "R" or an "N" (not usable for HRS purposes).

USING "U" QUALIFIED DATA

The "U" qualifier simply means that the reported concentration of the analyte was at or below the CRQL–there can be confidence that the true concentration is at or below the quantitation limit. Therefore, "U" qualified data can be used for establishing background levels. If the release sample concentration is above this level, as specified in the HRS, an observed release can be established. The quantitation limit for that analyte could be used as a maximum background concentration if a more conservative background level seems appropriate.

USING "J" QUALIFIED DATA

As discussed previously, some "J" qualified data can be used in establishing an observed release if the uncertainty in the reported values is documented. Qualified data should always be carefully examined by the Regions to determine the reasons for qualification before use in HRS evaluation. Resampling and/or reanalysis may be warranted if qualified data only marginally document an observed release. Whenever possible, qualified data should be used in conjunction with non-qualified data.

As described in Exhibit 2, "J" qualified data indicates that bias has been detected in the sample analysis and although the analyte is definitively present, the reported concentration is an estimate. Depending on the reasons and the direction of bias, with the use of adjustment factors, "J" qualified data can represent data of known and documented quality sufficient for use in establishing an observed release and observed contamination under the HRS.

USING "UJ" QUALIFIED DATA

A combination of the "U" and "J" qualifiers indicates that the reported value may not accurately represent the concentration necessary to positively detect the analyte in the sample. Under limited conditions, "UJ" qualified data can be used to represent background concentrations for establishing an observed release. These conditions are: instances when there is confidence that the background concentration is not detectable above the CRQL, the background concentration is biased high, and the sample measurement establishing the observed release equals or exceeds the CRQL.

DIRECTION OF BIAS IN "J" QUALIFIED DATA

It is important to understand the direction of bias associated with "J" qualified data before using the data to document an observed release. Qualified data may have high, low, or unknown bias. A low bias means that the reported concentration is likely an underestimate of the true concentration. For example, data may be biased low when sample holding times for volatile organic compounds (VOCs) are moderately exceeded or when recovery of QA/QC compounds is significantly less than the amount introduced into the sample. Low surrogate recovery would also indicate a low bias. A high bias means the reported concentration is likely an overestimate of the true concentration. For example, data may be biased high when recovery of QA/QC compounds is significantly higher than the amount in the sample. A bias is unknown when it is impossible to ascertain whether the concentration is an overestimate or an underestimate. For example, an unknown bias could result when surrogate recoveries exceed method recovery criteria and matrix spike/matrix spike duplicate compounds below method recovery criteria fail the relative percent difference (RPD) criteria in the same sample.

Despite the bias, certain qualified data may be used without application of adjustment factors for determining an observed release under certain circumstances. The following are examples of using "J" qualified data without adjustment factors:

- Low bias release samples are likely to be underestimates of true concentrations. If the reported concentration of a low bias release sample is three times above unbiased background levels, these release samples would still meet the HRS criteria. The true concentrations would still be three times above the background level.

- High bias background samples are likely to be overestimates of true concentrations. If the reported concentration of unbiased release samples are three times above the reported background concentration, they would still meet the HRS observed release criteria because they would still be three times above the true background concentration.

The above examples show that both low bias "J" qualified release samples at their reported concentrations and high bias "J" qualified background samples may be used at their reported concentrations in these situations.

High bias release samples may not be used at their reported concentrations because they are an overestimate of true concentrations in this situation; resampling and/or re-analysis of the release samples should be considered. The true difference in the background and release concentrations may be less than the HRS criteria for establishing an observed release. The reported concentration for low bias background concentrations may not be compared to release samples because it is most likely an underestimate of background level; the release sample concentration may not significantly exceed the true background concentration. However, in lieu of re-sampling and/or re-analysis, high bias release data and low bias background data may be used with adjustment factors which compensate for the probable uncertainty in the analyses.

ADJUSTMENT FACTORS FOR BIASED "J" QUALIFIED DATA

Applying adjustment factors to "J" qualified data will enable EPA to be more confident that the increase in contaminant concentrations between the background and

EXHIBIT 2
EPA CLP DATA QUALIFIERS AND THEIR USABILITY FOR DOCUMENTING AN OBSERVED RELEASE

Usable*		Not Usable	
"U"	The substance or analyte was analyzed for, but no quantifiable concentration was found at or above the CRQL (*CLP National Functional Guidelines for Data Review*).	"N"	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification" (*CLP National Functional Guidelines for Data Review*).
"J"	The analyte was positively identified--the associated numerical value is the approximate concentration of the analyte in the sample. The "J" qualifier indicates that one or more QA/QC requirements have not met contract required acceptance criteria, but the instrumentation was functioning properly during the analysis. For example, a "J" qualifier may indicate that the sample was difficult to analyze or that the value may lay near the low end of the linear range of the instrument. "J" data are considered biased, but provide definitive analyte identification (*CLP National Functional Guidelines for Data Review*).	"R"	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte can not be verified and the result has been rejected. A sample result may be qualified with an "R" qualifier when the instrument did not remain "in control" or the stability or sensitivity of the instrument were not maintained during the analysis (*CLP National Functional Guidelines for Data Review*).
"UJ"	The analyte was not quantifiable at or above the CRQL. In addition to not being quantifiable, one or more QA/QC requirements have not met contract acceptance criteria (*CLP National Functional Guidelines for Data Review*).	"NJ"	The analysis indicates the presence of the analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration (*CLP National Functional Guidelines for Data Review*).

* Usable under certain circumstances as explained in this fact sheet.

release samples is due to a release. The adjustment factors are applied as "safety factors" to compensate for analytical uncertainty, allowing biased data to be used for determining an observed release. Dividing the high bias result by an adjustment factor deflates it from the high end of the acceptable range towards a low bias value. Multiplying a low bias concentration by an adjustment factor inflates it to the high end of the acceptable range.

Tables 1 through 4 (pages 11 - 18) present analyte and matrix-specific adjustment factors to address the analytical uncertainty when determining an observed release using high bias release samples and low bias background data. The factors are derived from percent recoveries of matrix spikes, surrogates, and laboratory control samples in the CLP Analytical Results Database (CARD) from January 1991 to March 1996. A total of 32,447 samples were reviewed for volatile organic analytes; 32,913 samples for semivolatile organic analytes; 59,508 samples for pesticides/PCB analytes; and 5,954 samples for inorganic analytes.

The range of CARD data for each analyte includes 97 percent of all percent recoveries in the database, discarding outliers. The adjustment factors are ratios of percent recovery values at the 98.5 and 1.5 percentiles. The ratios generally show a consistent pattern.

Adjustment factors have been determined for all analytes in the CLP Target Compound List (organic analytes) and Target Analyte List (inorganic analytes). A tiered approach was used to derive the organic adjustment factors. Percent recoveries for surrogates were examined first, followed by matrix spike recoveries. When both matrix spike and surrogate data were available for the same analyte, the larger adjustment factor (representing more extreme high and low percent recoveries) was used. Laboratory control samples were used to calculate the inorganic adjustment factors. Quarterly blind sample data were not used to determine adjustment factors because of the small data set available. A default adjustment factor of 10 was used for analytes when percent recovery data were unavailable.

Adjustment factors do not correct the biased sample concentration to its true value, as such "correction" is not possible. CARD data do not differentiate and quantify individual sources of variation. Instead, the ratio of percentile used to develop adjustment factors represents a "worst-case" scenario. Adjustment factors either inflate background values to the high end of the range or deflate release data to the low end. Therefore, adjustment factors compensate or adjust for the apparent analytical variability when comparing a high bias value to a low bias value (see Exhibit 3).

USING THE ADJUSTMENT FACTORS

This section of the fact sheet demonstrates how adjustment factors can be used with "J" qualified data for HRS scoring purposes, including documentation and detection limit issues.

Documentation Requirements for Using Qualified Data

In using "J" qualified data to determine an observed release, include a discussion of "J" qualifiers from the data validation report and cite it as a reference in the site assessment report or HRS documentation record. If adjustment factors are applied to "J" qualified data, reference and cite this fact sheet. These steps will ensure that the direction of bias is documented and will demonstrate how biases have been adjusted.

Detection Limit Restrictions

Adjustment factors may only be applied to "J" qualified data with concentrations above the CLP CRQL for organics or CRDL for inorganics. "J" qualified data with concentrations below the CRQL can not be used to document an observed release except as specified in the previous section entitled "Using "UJ" Qualified Data."

Application of Factors

Exhibit 3 shows how to apply the factors to "J" qualified data. Multiply low bias background sample results by the analyte-specific adjustment factor or the default factor of 10 when an analyte-specific adjustment factor is not available. The resulting new background value effectively becomes a high bias value that may be used to determine an observed release. Divide high bias release sample data by the analyte-specific adjustment factor or the default factor of 10 when an analyte-specific adjustment factor is not available. The resulting new release sample value effectively becomes a low bias value that may be used to determine an observed release.

Note: High bias background data, low bias release data, and unbiased data may be used at their reported concentrations.

Note: Adjusted release and background values must still meet HRS criteria (e.g., release concentration must be at least three times above background level) to determine an observed release.

Examples Using Trichloroethene in Soil and Water

1. *Release water sample is unbiased, background water sample is unbiased but all data are qualified with a "J" due to an contractual laboratory error not analytical error.*

Background sample value: 12 μg/L (J) *no bias*
Release sample value: 40 μg/L (J) *no bias*

The CRQL for trichloroethene is 10 μg/Kg for soil and 10 μg/L for water.

In this example, the qualification of the data is not related to bias in the reported concentrations. Thus, using adjustment factors is not needed and an observed release is established if all other criteria are met.

2. *Release soil sample data is biased low, background soil sample data is biased high.*

Background sample value: 12 μg/Kg (J) *high bias*
Release sample value: 40 μg/Kg (J) *low bias*

In this example, the direction of bias indicates that the true release value may be higher and the true background value may be lower than reported values. The release sample concentration still exceeds background by more than three times, so an observed release is established, provided all other HRS criteria are met. Using adjustment factors is not needed.

EXHIBIT 3 USE OF ADJUSTMENT FACTORS FOR "J" QUALIFIED DATA		
Type of Sample	**Type of Bias**	**Action Required**
Background Sample	No Bias	None: Use concentration without factor
	Low Bias	Multiply concentration by factor
	High Bias	None: Use concentration without factor
	Unknown Bias	Multiply concentration by factor
Release Sample	No Bias	None: Use concentration without factor
	Low Bias	None: Use concentration without factor
	High Bias	Divide concentration by factor
	Unknown Bias	Divide concentration by factor

3. *Release soil sample data is unbiased, background soil sample is biased low.*

Background sample value: 12 μg/Kg (J) *low bias*
Release sample value: 30 μg/Kg *no bias*

In this example, the true background value is assumed to be less than the reported value; however, an observed release may still be possible. To use the data to establish an observed release, multiply the background sample data value by the adjustment factor given for trichloroethene in soil (2.11). No adjustment factor is needed for the release sample.

New background sample value:
(12 μg/Kg) x (2.11) = 25.32 μg/Kg (J) *high bias*

The release sample concentration does not meet or exceed the new background level by three times, so an observed release is not established.

4. *Release water sample data is biased high, background water sample data is unbiased.*

Background sample value: 15 μg/L *no bias*
Release sample value: 70 μg/L (J) *high bias*

In this example, the true release value may be lower than the reported value; however, an observed release may still be possible. To use the data to establish an observed release, divide the release sample by the adjustment factor for trichloroethene in water (1.66). No adjustment factor is needed for the background sample.

New release sample value:
(70 μg/L) + (1.66) = 42.17 μg/L (J) *low bias*

The new release sample concentration does not meet or exceed the background level by three times, so an observed release is not established.

5. *Release soil sample data has unknown bias; background soil sample data has unknown bias.*

The following example is the most conservative approach to using adjustment factors with qualified data.

Background sample value: 20 μg/Kg (J) *unknown bias*
Release sample value: 325 μg/Kg (J) *unknown bias*

In this example, it is not possible to determine from the reported values if an observed release is possible. To use the data to establish an observed release, divide the release sample value and multiply the background sample value by the adjustment factor given for trichloroethene in soil (2.11).

New release sample value:
(325 μg/Kg) + (2.11) = 154.03 μg/Kg (J) *low bias*

New background sample value:
(20 μg/Kg) x (2.11) = 42.2 μg/Kg (J) *high bias*

The new release sample is at least three times the new background concentration, so an observed release is established, provided all other HRS criteria are met.

ISSUES WITH USING ADJUSTMENT FACTOR APPROACH

Some issues were raised regarding the application of adjustment factors to qualified data during the Agency's internal review process.

One issue is that "J" qualifiers are added to analytical results for many reasons that may or may not affect the accuracy and precision of the analytical result. The application of an adjustment factor to "J" qualified data in which bias is not affected could be considered overly conservative.

All qualified data should be carefully evaluated to determine if the data are biased. Based on the reasons for bias, the use of an adjustment factor should only be considered as a management tool that provides a quick screening of the data for site assessment, not a means for correcting the biased value to a true value. Application of adjustment factors are intended for use with qualified data reported at or above the CRQL and may not be applicable to data which are qualified but technically sound. As stated previously, qualified data should always be carefully reviewed on a case-by-case basis prior to use in HRS evaluation.

Another issue is the validity of "10" as a default adjustment factor. A default adjustment factor of 10 was a policy decision based on the range of adjustment factors and an industry approach. The default was chosen in order to account for the maximum variability regardless of the direction of the bias. Therefore, the default value of 10 is generally considered to be a conservative adjustment factor. EPA reviewed the use of the default value of 10 and determined that this value was conservative.

Even if using adjustment factors is sometimes overly conservative, this approach is preferable to not using the data at all. EPA maintains a "worst sites first" policy that only the sites considered most harmful to human health and/or the environment should be listed. EPA considers the use of adjustment factors appropriate as a management decision tool. However, discretion is needed when applying adjustment factors. The use of adjustment factors may not be appropriate in all cases.

USE OF OTHER ADJUSTMENT FACTORS

EPA Regions may substitute higher, but never lower, adjustment factor values for the ones listed in this fact sheet on a case-by-case basis when technically justified. For example, other adjustment factors may be applied to conform with site-specific Data Quality Objectives (DQOs) or with Regional Standard Operating Procedures (SOPs) (*Data Quality Objectives Process for Superfund*, Publication 9355.9-01).

SUMMARY

For site assessment purposes, EPA Regions should not automatically discard "J" qualified data. However, site-specific data usability determinations may result in the data's not being used.

Data qualified under the EPA's CLP or from other sources of validated data may be used to demonstrate an observed release if certain measures are taken to ensure that the bias of the data qualifier is adjusted using the factor approach specified in this fact sheet. (This fact sheet provides a management decision tool for making qualified data usable for documenting an observed release.) The analyte and matrix-specific adjustment factors provided in Tables 1 through 4 of this fact sheet present these adjustment factors.

The scope of this fact sheet is limited to the situations described in Exhibit 1. The use of qualified analytical data without the adjustment factors presented in this fact sheet is limited. Higher adjustment factors may be substituted by EPA Regions on a case-by-case basis when technically justified by site-specific DQOs or SOPs.

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TABLE 1 FACTORS FOR VOLATILE ORGANIC ANALYTES				
	SOIL MATRIX		WATER MATRIX	
VOLATILE ORGANIC ANALYTES	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,1,1-TRICHLOROETHANE	—	10.0	—	10.0
1,1,2,2-TETRACHLOROETHANE	—	10.0	—	10.0
1,1,2-TRICHLOROETHANE	—	10.0	—	10.0
1,1-DICHLOROETHANE	—	10.0	—	10.0
1,1-DICHLOROETHENE	7,031	2.71	5,015	2.35
1,2-DICHLOROETHANE-D4	32,446	1.52	25,516	1.38
1,2-DICHLOROETHENE (TOTAL)	—	10.0	—	10.0
1,2-DICHLOROPROPANE	—	10.0	—	10.0
2-BUTANONE	—	10.0	—	10.0
2-HEXANONE	—	10.0	—	10.0
4-METHYL-2-PENTANONE	—	10.0	—	10.0
ACETONE	—	10.0	—	10.0
BENZENE	7,024	1.97	5,001	1.64
BROMODICHLOROMETHANE	—	10.0	—	10.0
BROMOFORM	—	10.0	—	10.0
BROMOFLUOROBENZENE	32,444	1.7	25,518	1.26
BROMOMETHANE	—	10.0	—	10.0
CARBON DISULFIDE	—	10.0	—	10.0

TABLE 1 FACTORS FOR VOLATILE ORGANIC ANALYTES				
	SOIL MATRIX		WATER MATRIX	
VOLATILE ORGANIC ANALYTES	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
CARBON TETRACHLORIDE	—	10.0	—	10.0
CHLOROBENZENE	7,018	2.0	5,015	1.54
CHLOROETHANE	—	10.0	—	10.0
CHLOROFORM	—	10.0	—	10.0
CHLOROMETHANE	—	10.0	—	10.0
CIS-1,3-DICHLOROPROPENE	—	10.0	—	10.0
DIBROMOCHLOROMETHANE	—	10.0	—	10.0
ETHYLBENZENE	—	10.0	—	10.0
METHYLENE CHLORIDE	—	10.0	—	10.0
STYRENE	—	10.0	—	10.0
TETRACHLOROETHENE	—	10.0	—	10.0
TOLUENE-D8	32,447	1.63	25,526	1.21
TRANS-1,3-DICHLOROPROPENE	—	10.0	—	10.0
TRICHLOROETHENE	6,988	2.11	4,938	1.66
VINYL CHLORIDE	—	10.0	—	10.0
XYLENE (TOTAL)	—	10.0	—	10.0

TABLE 2 FACTORS FOR SEMIVOLATILE ORGANIC ANALYTES				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,2,4-TRICHLOROBENZENE	6,792	4.83	4,605	3.71
1,2-DICHLOROBENZENE-D4	32,848	4.22	21,506	3.0
1,3-DICHLOROBENZENE	—	10.0	—	10.0
1,4-DICHLOROBENZENE	6,796	6.0	4,599	3.85
2,2'-OXYBIS(1-CHLOROPROPANE)	—	10.0	—	10.0
2,4,6-TRIBROMOPHENOL	32,605	9.38	21,509	3.57
2,4,5-TRICHLOROPHENOL	—	10.0	—	10.0
2,4,6-TRICHLOROPHENOL	—	10.0	—	10.0
2,4-DICHLOROPHENOL	—	10.0	—	10.0
2,4-DIMETHYLPHENOL	—	10.0	—	10.0
2,4-DINITROPHENOL	—	10.0	—	10.0
2,4-DINITROTOLUENE	6,798	4.88	4,623	3.52
2,6-DINITROTOLUENE	—	10.0	—	10.0
2-CHLORONAPHTHALENE	—	10.0	—	10.0
2-CHLOROPHENOL-D4	32,798	4.08	21,506	2.92
2-FLUOROBIPHENYL	32,913	3.38	21,532	2.84
2-FLUORPHENOL	32,781	5.05	21,511	3.34
2-METHYLNAPHTHALENE	—	10.0	—	10.0
2-METHYLPHENOL	—	10.0	—	10.0
2-NITROANILINE	—	10.0	—	10.0
2-NITROPHENOL	—	10.0	—	10.0
3,3'-DICHLOROBENZIDINE	—	10.0	—	10.0
3-NITROANILINE	—	10.0	—	10.0
4,6-DINITRO-2-METHYLPHENOL	—	10.0	—	10.0
4-BROMOPHENYL-PHENYLETHER	—	10.0	—	10.0

TABLE 2 FACTORS FOR SEMIVOLATILE ORGANIC ANALYTES				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4-CHLORO-3-METHYLPHENOL	6,715	6.26	4,609	4.46
4-CHLOROANILINE	—	10.0	—	10.0
4-CHLOROPHENYL-PHENYLETHER	—	10.0	—	10.0
4-METHYLPHENOL	—	10.0	—	10.0
4-NITROANILINE	—	10.0	—	10.0
4-NITROPHENOL	6,627	9.33	4,586	5.96
ACENAPHTHENE	6,773	4.68	4,600	3.63
ACENAPHTHYLENE	—	10.0	—	10.0
ANTHRACENE	—	10.0	—	10.0
BENZO(A)ANTHRACENE	—	10.0	—	10.0
BENZO(A)PYRENE	—	10.0	—	10.0
BENZO(B)FLUORANTHENE	—	10.0	—	10.0
BENZO(G,H,I)PERYLENE	—	10.0	—	10.0
BENZO(K)FLUORANTHENE	—	10.0	—	10.0
BIS(2-CHLOROETHOXY)METHANE	—	10.0	—	10.0
BIS(2-CHLOROETHYL)ETHER	—	10.0	—	10.0
BIS(2-ETHYLHEXYL)PHTHALATE	—	10.0	—	10.0
BUTYLBENZYLPHTHALATE	—	10.0	—	10.0
CARBAZOLE	—	10.0	—	10.0
CHRYSENE	—	10.0	—	10.0
DI-N-BUTYLPHTHALATE	—	10.0	—	10.0
DI-N-OCTYLPHTHALATE	—	10.0	—	10.0
DIBENZ(A,H)ANTHRACENE	—	10.0	—	10.0
DIBENZOFURAN	—	10.0	—	10.0
DIETHYLPHTHALATE	—	10.0	—	10.0

TABLE 2 FACTORS FOR SEMIVOLATILE ORGANIC ANALYTES				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
DIMETHYLPHTHALATE	—	10.0	—	10.0
FLUORANTHENE	—	10.0	—	10.0
FLUORENE	—	10.0	—	10.0
HEXACHLOROBENZENE	—	10.0	—	10.0
HEXACHLOROBUTADIENE	—	10.0	—	10.0
HEXACHLOROCYCLOPENTADIENE	—	10.0	—	10.0
HEXACHLOROETHANE	—	10.0	—	10.0
INDENO(1,2,3-CD)PYRENE	—	10.0	—	10.0
ISOPHORONE	—	10.0	—	10.0
N-NITROSO-DI-N-PROPYLAMINE	6,725	4.92	4,513	4.0
N-NITROSODIPHENYLAMINE(1)	—	10.0	—	10.0
NAPHTHALENE	—	10.0	—	10.0
NITROBENZENE-D5	32,867	3.96	21,533	2.73
PENTACHLOROPHENOL	6,597	72.5	4,550	10.12
PHENANTHRENE	—	10.0	—	10.0
PHENOL-D5	32,855	3.85	21,489	3.53
PYRENE	6,543	11.86	4,612	5.67
TERPHENYL-D14	32,899	4.35	21,541	6.32

TABLE 3 FACTORS FOR PESTICIDES/PCB ANALYTES				
	SOIL MATRIX		WATER MATRIX	
VOLATILE ORGANIC ANALYTES	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4,4'-DDD	—	10.0	—	10.0
4,4'-DDE	—	10.0	—	10.0
4,4'-DDT	5,343	12.82	3,850	7.14
ALDRIN	5,526	14.26	3,829	6.63
ALPHA-BHC	—	10.0	—	10.0
ALPHA-CHLORDANE	—	10.0	—	10.0
AROCLOR-1016	—	10.0	—	10.0
AROCLOR-1221	—	10.0	—	10.0
AROCLOR-1232	—	10.0	—	10.0
AROCLOR-1242	—	10.0	—	10.0
AROCLOR-1248	—	10.0	—	10.0
AROCLOR-1254	—	10.0	—	10.0
AROCLOR-1260	—	10.0	—	10.0
BETA-BHC	—	10.0	—	10.0
DECACHLOROBIPHENYL	57,315	17.79	33,592	10.0
DELTA-BHC	—	10.0	—	10.0
DIELDRIN	5,539	11.93	3,861	4.87

TABLE 3 FACTORS FOR PESTICIDES/PCB ANALYTES				
VOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ENDOSULFAN I	—	10.0	—	10.0
ENDOSULFAN II	—	10.0	—	10.0
ENDOSULFAN SULFATE	—	10.0	—	10.0
ENDRIN	5,521	14.13	3,850	5.33
ENDRIN ALDEHYDE	—	10.0	—	10.0
ENDRIN KETONE	—	10.0	—	10.0
GAMMA-BHC (LINDANE)	5,545	11.79	3,832	10.0
GAMMA-CHLORDANE	—	10.0	—	10.0
HEPTACHLOR	5,548	7.88	3,836	5.26
HEPTACHLOR EPOXIDE	—	10.0	—	10.0
METHOXYCHLOR	—	10.0	—	10.0
TETRACHLORO-M-XYLENE	59,508	8.5	33,787	5.29
TOXAPHENE	—	10.0	—	10.0

TABLE 4 FACTORS FOR INORGANIC ANALYTES				
INORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ALUMINUM	5387	1.66	6208	1.30
ANTIMONY	5392	1.98	6170	1.27
ARSENIC	5675	1.74	6303	1.35
BARIUM	5360	3.99	6201	1.25
BERYLLIUM	5399	1.28	6208	1.25
CADMIUM	5385	1.41	6166	1.29
CALCIUM	5383	1.28	6201	1.24
CHROMIUM	5389	1.29	6210	1.30
COBALT	5392	1.25	6212	1.27
COPPER	5394	1.22	6205	1.25
CYANIDE	3281	1.55	225	1.36
IRON	5391	1.34	6216	1.27
LEAD	5982	1.44	6384	1.31
MAGNESIUM	5397	1.23	6210	1.24
MANGANESE	5395	1.24	6214	1.28
MERCURY	5954	1.83	256	1.50
NICKEL	5400	1.35	6210	1.29
POTASSIUM	3874	17.49	6175	1.24
SELENIUM	5620	2.38	6278	1.41
SILVER	5392	1.74	6215	1.42
SODIUM	5024	25.43	6195	1.26
THALLIUM	5621	1.86	6253	1.37
VANADIUM	5393	1.34	6212	1.25
ZINC	5404	1.50	6224	1.29

Reference No. 26

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINES RECLAMATION BUREAU

ABANDONED HARDROCK MINE PRIORITY SITES

DATA VALIDATION AND EVALUATION REPORT

Prepared For:

Montana Department of State Lands
Abandoned Mine Reclamation Bureau
1625 Eleventh Avenue
Helena, Montana 59620

Prepared By:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

Engineering Services Agreement DSL-AMRB No.94-006

DECEMBER 1994

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Cont'd)

1.0 INTRODUCTION

This document is a summary of the validation and evaluation of the analytical data collected during the 1994 Montana Department of State Lands/Abandoned Mines Reclamation Bureau (MDSL/AMRB), Abandoned Mines Hazardous Materials Inventory. The Hazardous Materials Inventory was conducted during the summer of 1994 and supplements the 1993 Hazardous Materials Inventory. The data discussed in this report represent the analytical results of source (tailings, waste rock, slag, etc.), soil, sediment, surface water, and groundwater samples. The data include the analytical results reported by the laboratory, as well as data provided by the field portable X-Ray Fluorescence (XRF) Spectrometer. Pioneer Technical Services, Inc. (Pioneer) has prepared this Data Validation and Evaluation Report for MDSL/AMRB under the provisions of the Engineering Services Agreement DSL-AMRB No. 94-006.

The objectives of the Data Validation and Evaluation Report include:

- summarize the laboratory data validation process according to U.S. Environmental Protection Agency (EPA) guidelines;
- summarize the XRF data validation process, performed according to guidelines provided by the instrument manufacturer;
- evaluate the laboratory data using a precision, accuracy, representativeness, completeness, and comparability (PARCC) statement according to EPA guidelines; and
- evaluate the overall precision and representativeness of the field XRF data using standard statistical comparison techniques, and compare field-generated XRF data to analytical laboratory generated data.

2.0 DATA VALIDATION

Data validation is the process of determining the limitations of analytical data after the data have been reported by the laboratory or the XRF spectrometer. The analytical laboratory utilized for this investigation (MSE, Inc.) complied with the EPA's Contract Laboratory Program (CLP) Statement of Work (SOW). The CLP SOW outlines reporting and deliverable requirements, analytical methods, quality assurance/quality control (QA/QC) procedures, etc. The MSE Laboratory complied with all of the QA/QC performance requirements defined in the CLP SOW when analyzing the samples for this investigation; however, the data packages did not include the extensive QA/QC documentation specified by the CLP SOW. The requested deliverable packages were modified to avoid unnecessary costs, yet still provide sufficient QA/QC information to allow comprehensive data validation and evaluation. Data evaluation occurred at the

620004

project office where a reviewer assessed the data by using the data validation guidelines developed by the EPA. The data validation process applied limitations to specific analytical data if certain conditions outlined in the EPA guidance documents were not met.

The limitations applied to the data were identified by data qualifiers (See Table 2-1). Knowing the limitations of the data assists the data user when making interpretations. Data with limitations (flagged data) are usable for interpretive purposes provided that the qualifications are considered. For example, a "J" flag indicates that the reported concentration was estimated (the laboratory did not meet the specified control limits for accuracy or precision, or a contaminant was detected above a certain level in a preparation blank, etc.). "J" flagged data meets the identification criteria (the analyte was definitely detected), but not the quantitation criteria (the concentration cannot be exactly quantified). After the validation process was complete, the data could be assigned into data use categories including: unrestricted (data receiving no qualification); restricted (qualified/flagged data); and, unusable (unrepresentative or "R" flagged data).

The laboratory data validated and evaluated for this investigation included a list of 14 metals from the CLP Target Analyte List (TAL). A total of 23 soil sample batches (246 individual samples) and 19 water sample batches (155 individual samples) were analyzed at the laboratory over the duration of the investigation; and 642 soil/sediment samples were analyzed in the field using the field portable XRF spectrometer.

The QA/QC performance requirements specified for laboratory data by the CLP were administered on a per batch basis with a restricted number of samples analyzed per batch (maximum of 20 samples per batch). For example, a laboratory preparation blank, laboratory duplicate, and matrix spike, etc., were analyzed with each batch, and the results of these QA/QC analyses were applicable to the entire batch.

When a sample was analyzed in the field using the XRF spectrometer, the analysis would take several minutes to complete; the exact length of time was controlled by the operator. The XRF instrument contains three radioactive sources (Fe55, Cd109, and Am241). These sources allow the quantification of the following elements: Fe55 - Cr; Cd109 - Cr, Mn, Ni, Cu, An, As, Hg, Pb; and Am241 - Cd. The analysis time was developed to maximize the exposure of the sample to the Cd109 source, since most of the analytes of concern are quantified using this source, yet keep the total analysis time under 10 minutes. Throughout the duration of each analysis, the XRF would analyze the sample several times and store several concentrations for each analyte in memory. When the analysis was complete, the concentration reported by the XRF represented the mean of the concentrations stored in memory for each analyte for a particular sample. The standard deviation was also reported with the mean concentration for each analyte.

The XRF data were validated by a data reviewer; the validation procedure consisted of comparing the reported concentration with the associated standard deviation. Per the instrument manufacturer's guidelines, any concentration that was less than three times

TABLE 2-1

INORGANIC DATA QUALIFIERS

DATA QUALIFIERS

[1]U - The material was analyzed for, but was not detected at the level of the associated value. The associated value represents the instrument detection limit (IDL).

[1]J - The associated value was an estimated concentration; the laboratory did not meet all required QA/QC objectives (e.g. precision and/or accuracy results outside control limits).

[1]R - The data were rejected as unusable; the flagged analyte may or may not be present (e.g. sample holding times exceeded, instrument not properly calibrated or not calibrated at specified frequency, laboratory QC samples outside control limits, etc.).

[1]UJ- The analyte was analyzed for, but was not detected. The associated value was an estimate and may be inaccurate or imprecise.

X - Data outlier based on statistical analysis of the entire data set. Data qualified with an "X" were not considered when determining overall precision and accuracy statements.

[1] From Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (USEPA 1988).

620006

(3X) the corresponding standard deviation was considered to be below the instrument detection limit (or not distinguishable from background) and was not reported. Those XRF data reported where the concentration was greater than 3X but less than 10X the standard deviation were flagged with a "*", indicating an estimated concentration. A "*" flag applied to XRF data is basically equivalent to a "J" flag applied to laboratory data (indicating an estimated concentration); however, the criteria used to apply each of these flags are different.

If the sample standard deviation information was not available for review (possibly omitted during the data downloading process, or hand recorded data was available for review without the associated standard deviation values), the XRF data were flagged with a "$", indicating that the data could not be properly validated according to the applicable criteria.

2.1 LABORATORY DATA VALIDATION RESULTS

The laboratory data were validated according to the document Laboratory Data Validation Functional Guidelines for Evaluating Inorganics (EPA, 1988). The data validation procedures were performed partially by the laboratory chemists, and partially by a Pioneer data reviewer. The overall data validation procedure included an evaluation of the following items:

- holding times;
- initial and continuing calibrations;
- calibration and preparation blanks;
- inductively coupled plasma (ICP) interference check samples;
- laboratory control samples (LCS);
- laboratory duplicate sample analyses;
- matrix spike sample analyses;
- furnace atomic absorption (AA) quality control (QC);
- ICP serial dilutions;
- sample result verification;
- field duplicate samples; and
- overall assessment of data for the batch.

The following is a brief summary of the validation results for the soil (solid matrix) and water data reported for this investigation. The most intensive data validation procedures were performed on the data reported by the laboratory (in accordance with EPA Guidelines).

Holding time requirements were met for all water samples submitted to the laboratory. Holding time requirements have not been established for soil samples; however, if the water holding time criteria were applied to soil samples, no holding time exceedences occurred for soils. Additionally, all initial and continuing calibration requirements were met for soil and water samples for the entire data set (all sample batches). Typically, if the laboratory fails to meet the CLP-specified calibration requirements, samples are not analyzed until corrections are made and the calibration criteria are satisfied.

620007

No contaminants were detected above the CLP Contract Required Detection Limit (CRDL) in water sample preparation blanks for the entire data set. However, one analyte (cadmium) was detected above the CRDL in one soil sample preparation blank. This resulted in flagging 4.3% of the cadmium data as estimated concentrations ("J" flag). The requirements for running and meeting the control limits for ICP interference check samples were met for all soil and water samples, and Laboratory Control Sample (LCS) results were in control for all soil and water analyses. Typically, if the laboratory fails to meet these CLP-specified requirements, the affected samples are re-analyzed until the results for these QC samples are within the specified control limits.

Laboratory duplicate analyses yielded the following results. For the water analyses, the percentage of data qualified for each analyte where laboratory duplicate results were not within the CLP-specified control limits (± 20%) for concentrations >5x the CRDL are listed in Table 2-2 (the affected data were flagged "J"). Similarly, laboratory duplicate results for soil analyses that were not within the CLP-specified control limits (± 35%) for concentrations >5x the CRDL are also listed in Table 2-2 (the affected data were flagged "J").

TABLE 2-2

DATA QUALIFIED DUE TO LABORATORY DUPLICATE RESULTS OUTSIDE CLP-SPECIFIED CONTROL LIMITS

Analyte	Qualified Water Data	Qualified Soil Data
Antimony	10.5%	4.3%
Arsenic	15.8%	30.4%
Barium	0.0%	8.7%
Cadmium	15.8%	21.7%
Chromium	10.5%	30.4%
Cobalt	5.3%	17.4%
Copper	5.3%	13.0%
Iron	13.0%	8.7%
Lead	36.8%	13.0%
Mercury	10.5%	8.7%
Manganese	10.5%	17.4%
Nickel	10.5%	17.4%
Silver	21.1%	26.1%
Zinc	15.8%	8.7%

620008

Matrix spike results (water and soil) that were not within the CLP-specified accuracy range (75% - 125% for both matrices) caused the entire batch to be qualified with a "J" flag (for the specific analyte exceeding the control limit). Table 2-3 lists the percentage of data qualified for each analyte and media based on matrix spike results:

TABLE 2-3

DATA QUALIFIED DUE TO MATRIX SPIKE RESULTS OUTSIDE CLP-SPECIFIED ACCURACY RANGE

Analyte	Qualified Water Data	Qualified Soil Data
Antimony	0.0%	69.6%
Arsenic	0.0%	0.0%
Barium	0.0%	0.0%
Cadmium	0.0%	13.0%
Chromium	0.0%	8.7%
Cobalt	0.0%	0.0%
Copper	0.0%	8.7%
Iron	0.0%	0.0%
Lead	0.0%	4.3%
Mercury	0.0%	39.1%
Manganese	0.0%	26.1%
Nickel	0.0%	4.3%
Silver	5.3%	8.7%
Zinc	0.0%	8.7%

The furnace AA QC requirements for duplicate injections and post digestion spikes and the ICP serial dilution requirements were met for all soil and water samples for the entire data set. Sample result verification determined that all soil and water quantitation results were accurate. An overall assessment of the data indicates that all data were usable with some limitations. More limitations were associated with the soil data due to usual matrix effects. The matrix effects were demonstrated by more frequent control limit exceedences for duplicate analyses and matrix spike analyses with soil analyses than with water analyses. The water data have relatively few limitations; the most frequent problem encountered with the water analyses was laboratory duplicate results outside CLP-specified control limits.

620009

2.2 XRF DATA VALIDATION RESULTS

The XRF data were validated according to manufacturer specifications (currently no EPA guidelines exist for validating/evaluating XRF data) and the data that fell outside the manufacturer's guidelines were appropriately flagged or not reported. Table 2-4 lists the percentage of XRF data qualified for each analyte.

TABLE 2-4

PERCENTAGE OF XRF DATA QUALIFIED

Analyte	No. of Samples Above Detection Limit	Qualified Soil Data
Antimony	202	79.2%
Arsenic	371	55.8%
Barium	565	10.3%
Cadmium	70	98.6%
Calcium	641	3.4%
Chromium (Hi)	33	93.9%
Chromium(Lo)	65	98.5%
Cobalt	61	98.4%
Copper	387	73.1%
Iron	641	3.3%
Lead	484	20.9%
Manganese	476	66.4%
Mercury	29	100%
Molybdenum	281	84.0%
Nickel	51	100%
Potassium	642	4.5%
Rubidium	612	24.0%
Silver	127	96.1%
Strontium	631	17.6%
Thorium	317	89.0%
Tin	8	100%
Titanium	616	27.8%
Uranium	95	98.9%
Zinc	594	44.8%
Zirconium	639	6.6%

The criteria used to validate XRF data is very different from the criteria used to validate laboratory data. Laboratory data validation procedures are based on instrument performance while XRF data validation is based, indirectly, on the achieved detection limit on a sample for each individual analyte. Therefore, a high percentage of flagged data for

620010

a particular analyte listed on Table 2-4 indicates that a high percentage of the measured concentrations were relatively low (at or near the detection limit for the analyte). A high percentage of flagged XRF data does not necessarily indicate poor data quality.

XRF duplicate data (samples analyzed twice in the field) were compared to CLP-specified control limits for precision; the results are presented in Table 2-5. Table 2-5 is for comparison purposes only, duplicate data outside the ± 35% relative percent difference (RPD) control limit is not a validation criterion for XRF data. The purpose of this comparison is to illustrate the excellent precision attained by the XRF for most analytes. Table 2-5 is based on 22 XRF duplicate pairs analyzed in the field.

TABLE 2-5

PERCENTAGE OF XRF DATA OUTSIDE CLP-SPECIFIED CONTROL LIMITS FOR PRECISION

Analyte	No. of Dup. Pairs Above Detection Limit	RPD > +/-35%
Antimony	9	11.1%
Arsenic	11	9.1%
Barium	21	4.8%
Cadmium	3	0.0%
Calcium	22	0.0%
Chromium	3	33.0%
Copper	13	0.0%
Iron	22	0.0%
Lead	19	5.3%
Manganese	15	33.0%
Molybdenum	17	11.8%
Nickel	2	50.0%
Potassium	22	0.0%
Rubidium	21	0.0%
Silver	8	25.0%
Strontium	22	4.5%
Thorium	11	36.4%
Titanium	22	0.0%
Uranium	4	0.0%
Zinc	19	5.3%
Zirconium	21	0.0%

620011

Reference No. 27

USEPA CONTRACT LABORATORY PROGRAM

STATEMENT OF WORK

FOR

INORGANICS ANALYSIS

Multi-Media

Multi-Concentration

Document Number ILM03.0

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit [1,2] (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

(1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use - ICP
Instrument Detection Limit (IDL) - 40
Sample concentration - 220
Contract Required Detection Limit (CRDL) - 3

PERSONAL COMMUNICATION MEMORANDUM

URS Greiner Woodward Clyde
307 North Jackson, Suite 200
Helena, Montana 59601
(406) 457-2902

Reference No. 28

Project Name: Basin Mining Area HRS **TDD #:** 9901-0021

Date of Personal Communication: June 17, 1999

URS participant: Kristin Cottle, Environmental Scientist

Participants: Kirby Gray, SVL Analytical, Inorganic Laboratory Supervisor

Location: Telecon **Phone Number:** (208) 784-1258

☒ **Original to File** ☒ **Copies to** Documentation Record

Subject: Phoned SVL Analytical to determine the solid matrix Contract Required Detection Limits for the Contract Laboratory Program (CLP), Statement of Work (SOW), Document number ILM02.0 (March 1990). The solid matrix CRDLs are required for the HRS package source data. Mr. Gray stated that the CDRLs did not change in CLP SOW versions ILM02, ILM03, or ILM04. The CDRLs are presented for the aqueous matrix in CLP SOW ILM02 (Ref. 48). To convert the aqueous matrix CRDL to the solid matrix CRDL the value must be multiplied by 0.2 (the solid matrix digestion factor); the resulting value is the solid matrix CRDL in parts per million (ppm) (mg/kg). Mr. Gray calculated the solid matrix CRDLs for the following substances:

Arsenic = 2 ppm	Mercury = 0.04
Cadmium = 1 ppm	Antimony = 12
Copper = 5 ppm	Manganese = 3
Lead = 0.6 ppm	Iron = 20
Zinc = 4 ppm	Silver = 2

Name: Kristin S. Cottle Date: 6/17/99

D:\Projects\START\Projects\basin\rev1\ref23 wpd:has

Montana Department of
ENVIRONMENTAL QUALITY

Reference No. 29

Marc Racicot, Governor

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • E-mail: www.deq.state.mt.us

October 17, 2000

Ms. Crystal Roberts	VIA FACSIMILE (303) 291-8296
URS Operating Services, Inc.
1099 18th Street
Suite 710
Denver, Colorado 80202

Dear Crystal:

RE: Basin Mining Area Hazardous Ranking Score (HRS)
Personal Communication Memorandum
From Kristin Cottle Regarding Conversation
With Kirby Gray, SVL Laboratory
Dated June 17, 1999

I have reviewed the above referenced communication memorandum regarding the aqueous matrix contract required detection limit (CRDL) conversion factor for aqueous to solid matrix CRDL used for the Basin Mine area HRS package. As this conversion factor is not site specific, it is applicable to the Barker Hughesville and Carpenter Snow Creek HRS packages.

If I can be of further assistance, please do not hesitate to call me at (406) 444-0491.

Sincerely,

Judy Reese

Judy Reese
Environmental Scientist